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ABSTRACT

Containing papers presented at a multinational conference, this document examines the development of computer assisted learning (CAL) in geography, and describes program and curriculum development, teacher education, and experiences and problems of countries using CAL. Specific papers include: "Computer Assisted Learning in Geographical Education in the Netherlands: Initial Steps on Virgin Soil" (Van Beckum); "Spatial Diffusion and C.A.L. in Geography: The Case of Spain" (Hernando); "Interactive Computer Assisted Learning in Geography" (Stoltman); "Institutional and Individual Curricular Responses to Computer Assisted Learning in New Zealand Geography" (Forer); "Palaeotechnic Impressions of Computer Assisted Learning in the United Kingdom" (Hall); "Scope and Progress of Geography CAL from the Computers in the Curriculum Project" (Watson); "Computer Assisted Learning in the Geography Classroom--Explorations with Video Tape" (Wiegand); "Teacher and Pupil Involvement in Creating Computer Programs in Geography" (Ferguson and Hones); "Aspects of Pre-service and In-service Teacher Education with Reference to Computer Assisted Learning in Geography" (Barr and Williams); and "Settlement Unit: a Coordinated Suite of Analytical Programs and Data Files Designed for a Specific Geography Syllabus" (Jennings). (RJ)

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INTERNATIONAL GEOGRAPHICAL UNION
COMMISSION ON GEOGRAPHICAL EDUCATION

COMPUTER ASSISTED LEARNING IN GEOGRAPHICAL EDUCATION

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Edited by
Norman J. Graves

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COMPUTER ASSISTED LEARNING

IN

GEOGRAPHICAL EDUCATION

edited by

NORMAN J. GRAVES

Papers Presented at an International Conference
on Computer Assisted Learning in Geographical Education
held at the
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Introduction

The Commission on Geographical Education of the International Geographical Union has a British Sub-Committee which in the past has commissioned research or organized conferences in preparation for forthcoming congresses. In 1978 the British Sub-Committee organized a conference on the problems of the 16-19 curriculum in geography and in 1983 it was decided to examine the developing field of computer assisted learning in geography. To this end invitations were sent to people known to be interested in this area of education and papers were read at the conference and software and hardware demonstrated.

This booklet consists of the edited papers presented at the conference. Although some countries have had longer experience of C.A.L. in geography than others, and some have been influenced by specific curriculum development projects and by commercially developed software, it seems clear as David Hall puts it, that we are still in the 'palaeotechnic era' in this field. Some have viewed the development of C.A.L. as similar to the growth (and subsequent decline) of programmed learning in education, but it seems clear that the use of computers in education is more akin to the use of a teaching aid, albeit a sophisticated teaching aid. Thus just as children in developed countries are currently using electronic calculators as an everyday teaching aid in mathematics, science and social science, so the children of tomorrow are likely to use computers from time to time as sources of information, as means of data processing and as simulators of real life situations. Thus it would seem to me that unlike programmed learning, computer assisted learning is here to stay.

The first two papers indicate some of the problems faced by those stepping out for the first time into the world of computer assisted learning, in these cases in the Netherlands and Spain (Jan van Beckum and Agustin Hernando) The next two papers yield the experiences of two countries that have progressed some way into the field of C.A.L. in geography namely the U.S.A. and New Zealand (Joseph Stoltman and Pip Forer). There follow five papers from the United Kingdom which deal with the introduction of C.A.L. (David Hall), the work of a curriculum development project (Deryn Watson), classroom experiences (Patrick Wiegand), program development (Iain Ferguson and Gerry Hones), teacher education for C.A.L. (Robert Barr and Michael Williams) and the use of data banks (Richard Jennings). Another contribution was a paper by Ashley Kent which is published separately in "Research and Research Methods in Geographical Education" under the title "Research in CAL".

I hope that these offerings may encourage others to develop their teaching in this area.

Norman J. Graves
April 1984

COMPUTER ASSISTED LEARNING IN GEOGRAPHICAL EDUCATION IN THE NETHERLANDS: INITIAL STEPS ON VIRGIN SOIL

Drs. J.D.F. van Beckum

COMPUTER ASSISTED LEARNING IN GEOGRAPHICAL EDUCATION IN THE NETHERLANDS: INITIAL STEPS ON VIRGIN SOIL

Drs. J.D.F. van Beckum

Introduction

I shall try to sketch briefly the development of education for information technology in the Netherlands against a background of conditions that have exerted a great influence on the diffusion, structure and quality of C.A.L. In doing so, I shall outline the context in which geographical education, as one of the pioneers, is trying to develop amidst earlier established disciplines. While here and there footpaths are visible, a frontier mentality prevails on desert land with individual freedom in all activities prevailing with its attendant risks and uncertainties as well as its advantages. An impression is given of the situation met by the individual teacher of geography in the Netherlands who has decided to explore the possibilities of C.A.L. That is the situation in which I myself was, when - at the beginning of 1982 - I came into contact with microcomputers. Initiatives taken subsequently form the framework of the next section followed by a summary of what has been developed and achieved in the Netherlands so far. Conclusions and recommendations complete this paper.

I should like to thank Professor Dr. Henriëtte Verduin-Muller of Utrecht University for giving me the opportunity to present this paper. It is owing to her stimulating and guiding discussions that several foot-prints made by the initial steps referred to in the title, might be my own. I should also like to thank H. Koppen of the Foundation for Curriculum Development in Enschede for his help.

Background: education - political hesitation

It is not my intention to explain that and why a political choice should precede the introduction of computers in education. But I do think it my task to outline the consequences of that particular choice not being made - as is the case in the Netherlands.
Rather than giving an enumeration of reasons and circumstances to explain this, I would like to mention some facts typifying the environment in which C.A.L. in the Netherlands is developing.

1. In the first place at the end of the sixties a Dutch programming language was developed on behalf of education, the so-called ECOL, acronym for: Educational Computer Language. This language designed for the modernisation of mathematics managed to escape attention to the extent that the committee in charge of writing a draft note on "Education and Information Technology" in May 1982 puts the question to the government whether a Dutch (!) programming language should be developed before starting a policy with regard to informatics education.

2. A second example: In 1983 the Department of Economic Affairs (!) gave financial aid for purchasing 10 microcomputers for each of a hundred secondary schools, which will be allowed to experiment freely for a period of two years. After that pioneering stage, more guided projects will be started in co-operation with the Ministry of Education and Sciences.

3. The amount the government reserved for the coming years for a limited number of experiments in the total field of C.A.L., is in violent contrast to the investments made every year for computer education in the United Kingdom, France and even in states like Minnesota.

On account of these facts we may state that, first, an influential choice, namely the preference for one or a few education computer languages has been delayed and, secondly, that people still disagree on the question as to the direction in which education for information technology should go. It will be clear that this deferred decision has an effect on the development of the computer education policy.

Thus, the Netherlands does not yet recognise national development projects on behalf of C.A.L., nor are there any funds to draw on, and no industry is willing to take any risky initiatives in the field of education.

There are, indeed, enthusiastic teachers trying to convince their Boards of Governors that microcomputers in the school should be given a chance. And they are having more or less success. The results are that, in a growing number of secondary schools one or a few microcomputers have been put into use, often because of the possibilities they are said to have for school-office purposes. In this way the universally praised principle of far-reaching autonomy in the Dutch educational system leads to a few - in this case less favourable - secondary effects. We mention the great variety of makes, types and designs of microcomputers that populate an unknown number of schools, the lack of a general view and co-ordination of what is being tried out, and also the pioneer level of software in circulation. Exchange of programs is still imperfect and is therefore only slight, while the compatibility of software is rather decreasing than increasing.

The most appropriate way for a teacher to meet with support in developing more know-how is to join a group of users of a particular type of microcomputer rather than an institute of education or a professional organisation.

In the autumn of 1982 the Centre for Education and Information Technology was established at the Twente University of Technology[1]. This centre financed by the Ministry of Education and Sciences, will have to become the central authority for the co-ordination of the development in the education-technical field.

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[1] Centrum voor Onderwijs en Informatie-technologie, COI, Technische Hogeschool Twente, Enschede, the Netherlands, tel. : 053-892190.

In addition, it will serve as an information centre and clearinghouse for software and as an advisory centre for the Minister. At the same time, the first information centre for C.A.L. was instituted, namely "TEACHIP-SOL"[2] intended to function as a regional point of support, the latter project being the result of private enterprise. The TEACHIP Foundation, for C.A.L.-minded teachers, managed to get accommodation in the buildings of a public institute of education, the Teachers Training Centre "SOL" of Utrecht. Promotion of insight into and the application of computers in education are the main goals.

Another group, "DIDACOM" [3] with similar objects in view stresses the didactic demands on hardware and software.
Both institutions are of recent date. The older one, TEACHIP, is three years old (1984).

Publishing Problems

It might be clear that publishers are in a difficult situation. For, the postponement of the choice of a programming language affects on all parties concerned. It prevents the setting-up of purposeful post-graduate courses, and those who disregard this fact risk backing the wrong horse. The Dutch-speaking market being small, the attractive power of C.A.L. for commercial producers of software is very low. Nevertheless, two educational software publishers have set to work in this field[4]. But in the attractive catalogues no more than a hundred educational programs are announced by both firms together. This number is the sum total of all disciplines, for all kinds of education and for all educational levels. Among these, not one program is designed for geography.

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[2] TEACHIP-SOL informatiecentrum, Archimedeslaan 16, Utrecht, the Netherlands, Tel.: 030 - 525111.

[3] DIDACOM, address: c/o Avenbeek 98, 2181 PZ Hillegom, the Netherlands.

[4] Those are: Malmberg, Den Bosch: Malmbergs Educatieve Software - MES and Educaboek, Culemborg: Educatieve Telesoftware Systeem - ETS.

Therefore, initiatives to develop geographical software will have to come from private individuals. But the number of geographers engaged in C.A.L. activities is still very limited. In fact, an appeal addressed to geographers with "computer experience" in November 1982 yielded only three reactions, including my own, despite the fact that it was placed in the most read periodical for geographers in the Netherlands.[5]

Private initiative soon encounters the next problem: software designers with the required know-how develop the most ingenious, but pseudo-educational games. Further, teachers having at their disposal enough educational experience for the development of software, lack the programming knowledge for producing functional material.

The fact that commercial publishers are looking forward to programs in the sense of manuscripts to be published explains why the birth of the first geographical computer program, "Made in Holland", has been delayed for a while.

Given the conditions outlined above, the temptation is to introduce foreign software into Dutch geographical education. As far as we know, no such introduction has taken place so far. Should foreign programs make their appearance in the Netherlands in the near future, it will be necessary to apply them cautiously, because

- first, Dutch education has had wished on it - the task of justifying the purchase of computer hardware and software. And the opinion prevails that C.A.L. - should contribute to the solving of bottle-neck situations in education, to which existing educational appliances offer no reasonable solution. This means that the justification for the acquisition of hardware and software cannot be borrowed from countries where different criteria and educational systems are in force;
- secondly, the geography curriculum in Dutch Grammar Schools differs from that, for example, in the United Kingdom or the United States. In the Netherlands no fieldwork, no research and no statistical manipulations are obligatory. If they do occur, it is due to private initiatives within the large margins the educational system allows, but, of course, no rights can be claimed;

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[5] De Nieuwe Geografen Krant, monthly periodical of the Royal Dutch Geographical Society, circulation 5500 copies.

- thirdly, it seems to us that foreign software should not be introduced before experience has been acquired with software produced in Holland, so that a well-founded selection can be made.

'Micro-climatic' circumstances

In the previous sections an attempt has been made to describe the political, financial and technical environment the geographer in the Netherlands meets when he becomes interested in C.A.L. Further the atmosphere that has grown inside schools around the phenomenon 'microcomputer' defines the current state of affairs as far as geography goes. Speaking from my own experience, the following story, will be recognised by many teachers of geography in the Netherlands.

As occure in many Dutch secondary schools, a microcomputer was procured by our school because of the multi-purpose-function ascribed to it in the manuals. This Apple II was placed in the school's office, complete with 'printer' and 'dual drive floppy disc'. But even before the office staff had made themselves familiar with the brand-new hardware, colleauges of mine from the disciplines of 'physics' and 'mathematics' seemed to have appropriated it. A course of "computer science", larded with needless and threshold-raising mathematical instructions, soon restricted access to the noble guild of computer experts.

Not being convinced that the use of computers should be reserved exclusively to the science subjects, I took my bearings on the principles of computer-languages, via the instruction book "BASIC FOR BEGINNERS"[6]
After an hour's study of the first 15 pages I realised I could design a "program" for interactive explanation about how to calculate population density. On the basis of the knowledge acquired, "software" about the calculation of scale and of birth-rates was added. Not heroic acts, but the first thresholds were crossed and the once magic-looking hardware became accessible to me.

At this stage I gained a certain status among the 'self-evident' experts in our school, although my vision of fields of application and didactics of C.A.L. differed clearly from established views. Relying on the knowledge of colleagues and making an appeal to my autodidactic abilities, I could stand the cataract of developments.

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[6]Prooijen, J.P.A. van, (1980): BASIC voor beginners. Deventer-Antwerpen, Kluwer Technische Boeken.

Initial steps

The author's first article in the Netherlands about C.A.L. and geography was published in April 1983 (Beckum 1983), while in February 1983 he delivered a first lecture on the same subject. This introductory lecture was primarily meant for a regional meeting of geographers in Utrecht, but it attracted an even larger number of interested teachers from all over the country. At this - one might say historic - meeting an intensive exchange of views took place. The subsequent discussion made it clear that

- C.A.L. in geography in the Netherlands is lacking (April 1983) in almost all kinds of information transfer and on all educational levels;
- The Ministry of Education and Sciences, being the appropriate source of facilities concerned in the Netherlands, will provide in the short term no financial support in behalf of C.A.L. in general and in the longer term perhaps only little;
- At the end of the sixties, in foreign countries a computer-assisted geographical information transfer was started and as a consequence ample educational know-how in this domain was acquired.

Realising those facts, a group of Dutch geographers has now been formed with the intention to introduce C.A.L. into Dutch education of geography. As yet this cluster, the ASCON group[7] is making a reconnaissance expedition in the gap between what has been achieved abroad and the present situation in their own country.

Out of this ASCON initiative plans were born for a national course to make interested geographers familiar with computer hardware and - if necessary borrowed from other disciplines - the various types of software. In March the first group of teachers started that course and it must be said that the course attracts an unthought-of interest. For the time being it will be repeated every month.
During the first lecture in February 1983 contacts were made to guarantee a number of lectures and workshops about C.A.L. in geography in Teacher Training Centres in the near future. A post-graduate course on the same subjects is also being prepared, organised by the Royal Dutch Geographical Society.

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[7] ASCON, acronym for Aardrijkskundige Software en Courseware Ontwikkeling (Geographical Software and Courseware Development).

In the Netherlands the interest being surprisingly large, an important 'step' is to record the interest and the increasing knowledge from the moment they arise. Now that a general view has been obtained of geographers interested in practising C.A.L. in the Netherlands, co-operation may easily be brought about in the years to come. The ASCON initiative is also responsible for the appearance of the first geographical software in the Dutch language. Although these are not copies of existing programs, the topics might be called 'classic', such as "Demography", "Climates", "Scales" and "Relations". Around these themes interactive, tutorial programs have been developed, designed for problem situations such as were interpreted by the co-operating Dutch geography educators.

From the foregoing it can be gleaned that during his training, the Dutch student of geographical education would acquire neither knowledge of nor experience in C.A.L. in his own country. The possibilities of practical work in institutions abroad do exist but the number of students making use of them is very small.

At the moment the Teachers Training Programme at the Geographical Institute of the State University of Utrecht, is the only one that offers an introductory lecture with workshop, being a standard portion of the curriculum since the Autumn of 1982.

Internal publications of the Geographical Institute of the Liberal University of Amsterdam, and of the Teacher Training Centres of Zwolle and Sittard indicate that geography education orientates itself on a broader front.

Dutch software

Given our position in relation to foreign countries, the level of software production, so far, in the Netherlands is not highly developed. A short comment, however, will be given about the first Dutch software. Two weighty arguments underlie the chosen structure, namely

- computer software will have to prove that it can offer reasonable alternatives for traditional education appliances in didactic bottle-neck situations;
- geography education forms part of an educational movement that accentuates the differentiation of the students of a class.

A third starting point of different order but nevertheless not to be ignored is the fact that, at best, the teacher of geography has access to one or more microcomputers. In secondary education, subject rooms with 6 or more microcomputers are an exception.

In the current Dutch educational system a lot of problems occur mainly when students change their type of school, set of subjects or level of study. Such irregularities combined with the arguments mentioned before, make it clear why individual application of C.A.L. was chosen. Memory capacities limit the size of programs to 16 or 32 Kb of most of the current microcomputers.

Therefore, the available software consists of tutorial dialogues, alternated with drills and tests to complete, revise the subject matter. Simulations are being designed concerning 'transport' and 'location of settlement'.

From now on in the Netherlands, the supply of geographical software is growing month by month (see the Appendix for a survey of Dutch Software).

In view of the early stage of this development results can hardly be reported. The collation of individual experiences is needed. The reactions of my own students stimulate me to continue along my present path. A marginal note should be made here that the school where I work has comparatively favourable computer equipment and time-table facilities[8]. But other geographical educators too, react positively to the initiatives and to the software. We should go too far if we asserted that the Dutch geographer is acquiring a taste for C.A.L., but he is showing a good appetite.

Conclusions and recommendations

Summarising we come to the following conclusions:

- Both literally and figuratively C.A.L. in the Netherlands finds itself at a pioneering stage in which there is plenty of room left for all sorts of hardware, systems and programming languages. A large amount of unco-ordinated and small-scale activities take place in most cases owing to private initiatives. In all this, geography has a positive exceptional position: the handicap of a relatively late start might turn out to be an advantage to geography education in the long run.

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[8] Computer subject room equipped with 6 CBM Commodore 4.0 microcomputers with cassette-recorder each, and one printer, next to this equipment one Apple II with floppy discs for the school's office, the computer being accessible to teachers.

- Commercial software publishers hardly seem to be interested in the potential market for geography education in the Dutch language. Particularly the low priority the Ministry of Education and Sciences has attached to computer assisted learning so far underlies this situation (April, 1983).
- Whilst waiting for professional institutes to show an interest in C.A.L. in geography in the Netherlands, a number of geographers have secured contacts and intellectual support by joining the ASCON group. During the pioneering stage this group might be the reference address for the geographical C.A.L. movement in the Netherlands.[9]

The geographical educationalists are becoming conscious of the relative backwardness with regard to C.A.L. At the same time we are pleased to note that geography is breaking out of a vicious circle in which "lack of know-how" forms an essential element.

Finally, we would like to make some recommendations in support of the developments that have been set going.

1. Study facilities should be started in the theory and methodology of information provision in Institutes of Geography Education concerning the use of computers both in regard to C.A.L. and to the use of databanks.
2. It is of great importance that geographical educators should be involved in the "hundred schools experiment" that will start in the Autumn of this year. The facilities will form a welcome completion to initiatives undertaken in a different context.
3. The "Geography" sections of the various Teacher Training Centres should orientate themselves, more intensively than they have done, on C.A.L. concerning the teaching of geography.
4. It is necessary that the Royal Dutch Geographical Society should create facilities to support the development and diffusion of C.A.L. We have in mind symposia, space in periodicals, but also the support of initiatives at an education policy level.

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[9] To contact ASCON the author's address has to be used for the time being viz. Nr. 10, Arie van de Heuvelstraat,
3981 CV Bunnik, the Netherlands
Tel.: 03405 - 64610.

5. In conclusion we will solicit frequent and intensive contacts with those institutes and colleagues abroad, who are practising C.A.L. In view of the small size of the Dutch-speaking market for geographical software it is recommended that close co-operation with geographical educators from the Dutch-speaking part of Belgium, be instituted.

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Appendix Survey of Dutch Geographical Software

All these ASCON-programs are interactive and designed for individual use on stand-alone microcomputers.
For further information contact the author.

Abbreviations:
T = Tutorial/instructional
S = Simulation
MS = Middle School
US = Upper School

Name	Topic	Type of C.A.L.	Educ. Level
"Klimaten"	Köppen's Climatic classification exercises, test	T	MS/US
"Demografie"	Standard Demographic concepts, calculations, exercises	T	MS/US
"Verbanden"	Geographical Relations, correlations, etc.	T	MS/US
"Schaal"	Scale, calculations, exercises	T	MS/US
"Lokaties" (in development)	Choice of settlement location		
"Transport" (in development)	Transport systems, traffic and costs, principles, decisions	T/S	MS/US

SPATIAL DIFFUSION AND C.A.L. IN GEOGRAPHY: THE CASE OF SPAIN

Agustin Hernando

Introduction

In an education based fundamentally on the spoken word, only partly affected by printing technology, the theme of CAL in geography can seem esoteric. The absence of relevant information published in Spanish is notable, as is the case generally for geographical education. Therefore, what follows is a sketch based on empirical facts and personal evaluation. As in an impressionist painting, I am trying to fill in just a few strokes, to outline the present situationand future possibilities.

I have chosen the theory of spatial diffusion as a framework to help to analyse the situation. The aim is to interpret and further understand the phenomenon by adopting a holist view and by trying to relate the centre of diffusion to the dependent periphery, to the pressures of existing forces, to the attitude of the potential adopter and predict as far as possible, the expansion of CAL in Spain.

The subject of CAL provokes two postures or attitudes in the teaching staff and others responsible; both are manifested openly or covertly. The first, manifested by a dynamic minority, is for its adoption, claiming to identify the idea of progress with the acceptance of all forms of advanced technology. The change which this community is experiencing, is orientated towards adoption, and therefore towards an improvement in the educational system equivalent to the use of other leading technologies in a similar way to other countrie. The opposite point of view, based on their past experiences and other arguments, is taken by those who attack the previous idea. At the same

time they propose alternatives, saying that progress does not follow just the path of advanced technology. Humanism, and non-dependence on exotic technology, are just some of the arguments used.

Context : Some Characteristics of the Spanish Education System

Change is a constantly used term in today's Spanish society. The same term is used as a result of inadequate structures, and with the aim of making teaching staff more conscientious, provoking new attitudes and giving a stimulus for the adoption of new ideas. The desire for change exists throughout society. We do not know, however, its incidence in the heart of the education community, governed and ruled by laws, principles and institutions that have changed very little not only in the last decades but since their very inception.

Spanish academic Geography, judging by research publications, shows its backwardness in work whose content and methodology can be called traditional. The same can be said about University syllabuses which have expanded greatly with the noticeable increase in Geography departments, during the last decade. These syllabuses generally follow traditional schemes containing General and Regional Geography, with an absence of thematic elements, methodology and applications. However, within this panorama, some university Geographers began to use computers in the 70's as a way to process numerical data collected in order to complete theses. The presence of Geography as a specialisation, associated with History in Arts Faculties, can explain the difficulties found in the adoption of quantitative views.

The education system, until recently centrally controlled, is divided into official centres financed by the state and private centres of a varied nature.

sometimes with greater resources. The personnel consists of specialised teachers in secondary schools where the subject of Geography is independently taught. Their training is carried out in departments of Geography and History, which explains the identification of geography with the Humanities. The introduction of microprocessors has been through mathematics departments.

At the same time, the non-existence of stimulus, the lack of suitable teaching staff, and the absence of professional channels of information, explain why some of the recent reforms that have affected Geography, have been only superficial when compared with those in Anglo-saxon countries. Up until now, the syllabuses followed in secondary education, consisted of two courses of one year each; one of Human Geography and World Economics, and the other on the History and Geography of Spain. The adoption of the recent radical Geography is a long way off at this level of education, not only by teachers, but also those responsible for the design of the curriculum.

It may help the understanding of the educational context of Spanish Geography to refer to existing information on government projects for the education system, in spite of their uncertain character. The nature of the centrally directed reforu carried so far, allow us to predict future changes, such as the raising of the minimum school leaving age to 16 years, and the corresponding modification in syllabuses. A partial decentralisation in education is taking place, as is a closer tie with other European syllabuses. Recently, the inclusion of a programme of computer training for mathematics students was forecast. This programme, however, due to start in the 1983-84 academic year, and affect Geography, has been stopped. At the moment there is no definite project affecting CAL; such as, for example, the establishment of a communications network which could connect computers from various educational centres, or the provision of resources for the future. Any initiative is

of an individual nature.

The limited experiments carried out to date, show that pupils are able to assimilate the introduction of the computer. Social demand and possible employment, generate sufficient interest and motivation.

The Existence of Resources : Hardware and Software

Undoubtedly, one prerequisite for the introduction of CAL, is the provision of resources and the availability of an infrastructure on which any action may rest. In our case, the principal universities preparing future teaching staff, have been in contact with computer centres to which mainly mathematics staff have had access since the end of the 60's. From the last decade on some Geographers have approached these centres with the aim of benefiting from the advantages of processing numerical data rapidly. The programs they have used have been made by experts in the field and in most cases, they have abandoned contact with the computer afterwards. There are no bibliographies for guidance; or programs available in Spanish. What there is, written in the last 3 to 5 years, aims to popularise English programs, bibliographies and departments.

It should be noted that the technological impact in Spanish universities, has been very weak and most noticeable in Arts colleges. As an example, there is a lack of technical personnel relating to audio-visual services in the Universities. At the moment there is a project to install computer terminals in different faculties of Barcelona University.

The training of existing teaching staff takes place at various levels, although preferably through short courses (about 20 hours), with the aim of showing the advantages of the computer for processing data. These courses are normally

the inspiration to start research, usually resulting in a doctoral thesis.

Existing Dynamic Factors

In this context, "What are the existing pressures, and what may modifications lead to?" Self-evidently, a dynamic innovative "centre" could provide standards for the adoption of new technology. This would influence a teaching staff ready and prepared to adopt such a practice, which in turn creates tension between "innovative" and "traditional" members. Only changes noted by the students act as a brake or accelerator on the process of change. Teachers do not enjoy having to adopt new ideas and procedures. Their main attribute is immobility. The adoption of CAL will always be in isolated cases and the fruit of a system of entropy. That is, it possesses a random character and is the result of individual interest. The economic recession in which we find ourselves, does not allow an extensive diffusion. However, aggressive publicity on the part of commercial distributors, and advertising which promises high expectations and promotes sales in other social areas, may be an important help.

Achievements to Date

Computers are used by some members of the University Geography teaching staff. Their use is mainly in the preparation of thesis and other research works. The objective is the processing of numerical data. This use began in the 70's with the elaboration of several theses, and to a lesser extent in other research, as shown by articles which have appeared in Spanish geographical journals. First contacts can be dated to the beginning of the 70's, mainly in those Universities possessing a suitable staff and a sufficiently flexible syllabus for its inclusion. The incorporation of this teaching can be dated to the

end of the last decade. At the same time some courses have been produced, (we only know of two - in the University of Madrid) organised by the Institute of Science Education, aimed at introducing non university teachers to research using this instrument.

To the aforementioned we must add that experiments have been started by other professionals, such as mathematicians, experts in computer programming and pedagogy, who have elaborated programs with geographic references. The subjects of demography and regional studies, are the only ones in existence to date, carried out by teams which do not include geographers. Computer centres and a few groups in University Mathematics departments, are the pioneers of this work. This activity is currently taking place in various parts of Spain.

At a secondary education level, this work has consisted of the introduction of the calculator and microprocessor by teachers demanding its use, for example in mathematics. In exceptional cases, other teachers have become interested in computers, for example physics, chemistry and natural science graduates. In Catalonia there is not one geography or history teacher using a microprocessor in class. In spite of the tentative nature of such innovations in secondary education, great interest has been shown in the subject and the acquisition of microprocessors in the last few years.

The other branch of secondary education, technical training, has also introduced computers and associated activities, related to the training of technicians. At times this has been through private entities, who have been more receptive to social demands.

Conclusion

The peculiarities of the Spanish education system partly explain the situation relating to the use of computers in education. Greater or lesser dependence on foreign technology, and the attitude of teachers with respect to "cultural colonialism" help to explain the existing panorama. However, the climate of change prevalent at the moment, may help to increase the use of the computer at different levels. Through a hierarchic diffusion in academic geography, mathematics and computer programming experts, a contageous diffusion will take place at other levels of education. The speed of such a process is difficult to estimate. Only pressure generated by sales forces, infra-structure investments, the appearance of incentives and changes in institutions, can speed up or slow down its use and dispersion. The gap which exists between education and other social activities such as industry and commerce, is notable and tending to increase.

The content of geographical education, whose character is still fairly traditional, and the absence of teachers trained in the use of CAL, make the general spreading of new ideas difficult. None of this allows us to be too optimistic for the next few years, especially bearing in mind that both these factors are subordinate to changes in academic geography in University departments and that there, apart from one or two exceptions, computers are still not generally used.

INTERACTIVE COMPUTER ASSISTED LEARNING IN GEOGRAPHY

Joseph P. Stoltman

The impact of computers upon education at the elementary and secondary levels in the United States is taking on proportions similar to the advent of the printing press and its subsequent effect upon the educational system. Whereas the cry was once heard for a textbook in the hands of every school student, the move toward a computer in every classroom has become the objective for many schools. A 1980 survey of computer equipment in 607 school districts (Chambers and Bark) revealed the following.

a) Ninety percent of the school districts used computers for either instructional or administrative activities. The ten percent which did not, had plans to incorporate computers in their operations within the next five years.

b) Seventy four percent of the school districts reported that computers were used for instruction, with an additional thirteen percent having plans to incorporate instructional aspects of computers within the next five years.

c) Fifty-four percent of the school districts responding had computer assisted instructional (CAI) strategies as a part of their curriculum. The CAI was principally at the secondary level and monopolized by the disciplines of mathematics, natural science, language study, and business studies.

Geography as a separate discipline is found infrequently in secondary schools in the United States. Rather, it is generally taught as a component of the social studies curriculum. The social studies as a curricular umbrella is making only moderate progress in the area of computer assisted instruction. It is expected that the major focus on the computer by researchers in the disciplines which formulate the social studies (primarily history, geography, government/civics, political science, and eco-

nomics) will diffuse to the secondary classroom slowly. One problem is that the preparation of entry level teachers in colleges and universities, where computer based research is taking place, is at an all time low. As a result the enhancement of computer assisted instructional opportunities in school geography must arise from the relatively few university geographers dedicated to geographical education, from social studies and geography teachers similarly inclined, from professional organizations, and from individuals and companies interested in computer assisted instruction for the potential monetary gain.

The situation just described is in stark contrast to the way in which geography as a discipline and the computer as a technology interact. Dr. John Kemeny recently spoke about computers in education and society at the University in the United States where I teach. Kemeny co-developed the BASIC language at Dartmouth College, now the most widely used of the numerous different computer languages. During a period of reflection upon his contributions to the growth of computer systems, he stated that the Geography Department at Dartmouth was one of the first academic areas to recognize the computer assisted instructional (CAI) potential of BASIC and incorporate it into the curriculum. This story simply adds credence to how perfectly the computer is suited for geography instruction. Notice, I did not say how suited geography is for the computer. It must be remembered that the computer is the servant, the discipline the master. The discipline of geography has a viewpoint and a theoretical perspective which are particularly well suited for incorporating the computer as a tool. There are three basic reasons to support this position.

First, geography is a data dependent, data based spatial science. The data of geography are found across earth space and reflect numerous such distributions. Whether the data are representing the amount of some object per square unit of land surface or the precise location of a particular item, the spatial qualities of location, area and quantity are essential elements in geographic inquiry which are readily accommodated by computer technology.

Second, a key concept and managing variable in all geographic study is scale. Scale is accommodated equally well by the computer whether it is represented statistically or graphically. In fact, the graphics capabilities of the computer present opportunities for increasing the visual element of geographic study. The potential in this element of computer capability may exceed all others combined and has experienced relatively little development for its Computer Assisted Learning (CAL) attributes or potentials.

Third, the behavioral dimensions of geography involve earth space and quantifiable dimensions of cultural groups and individuals residing therein. The measurable responses which reflect behavior or actions are always in response to a set of measurable spatial or environmental conditions. This third attribute of geography is readily amenable to the computer.

Computing and the Geography Curriculum

Computers serve at least three educational functions in the classroom: 1) as a stand alone instructional device; 2) as an assist or instructional support device; and 3) as an experimental technology which fosters discovery or inquiry. However, it is common knowledge that the curriculum is larger than the activities encountered in the classroom. Therefore, the

geography curriculum and the discipline of geography must be reviewed in order to identify where it is the computer can be beneficially engaged. On the other hand, the computer, if to be incorporated in the learning process, must enable the user, both teacher and student, to make some intellectual improvement. That improvement may be the increase of efficiency in learning more effectively what is currently being learned. It may make possible learning the material in a shorter period of time or with better retention, or breadth of learning, enabling the learner to cover more topics in geography in a given amount of time. It may permit the students to pursue selected topics in greater depth, relying upon the computer program to permit ever greater probing of a geographic question. The curricular effects of these possibilities are represented in Table 1.

Table 1

Content

CAL	Efficiency	Breadth	Depth
Stand Alone	Modules having closure; Recommended instructional data	Individual instruction	Individual instruction
Assist	Facts, concepts, data tutorial help, graphs, maps, diagrams, infor-tion	World data bank; conceptual data bank cross referencing	Tutorial help
Inquiry	Discovery Simulation	Range of theory; Simulation	Case studies into theory

Geography teachers have numerous instructional concerns, but they are ultimately concerned with having students inquire regarding theories in the discipline. Numerous academic treatments of the discipline have

postulated theories which have been incorporated into curriculum development. The teacher may find it advantageous to rely upon several of the curriculum oriented projects (HSGP, the Oxford Geography Project, the 16-19 Geography Project, to name only a few) or the curriculum theory works by Graves (1982), Slater (1982) and others from which to draw ideas for computer assisted learning activities. Beyond these are the multitude of journals in geography, textbooks for school and tertiary levels and publications having geographic significance in the popular media (newspapers, newsmagazines, etc.) Those materials and the related geographic theories must be evaluated for their potential in CAL.

The move forward into CAL in Geography must be tempered here with several qualifications. First, the idea or original thought for a CAL activity will usually arise from experts in the field. These are geography professors, teachers, and curriculum specialists. However, they may also include people in planning, environmental studies and location analysts who also have a firm conceptual grasp of geographic theory.

Second, most writing of sophisticated CAL software will be completed by skilled programmers. While this will often be in conjunction with a geography specialist, the computer competencies necessary to design CAL software requiring 48K or more of storage and numerous arrays in order to develop the interactive aspects necessary are truly the domain of the accomplished computer programmer.

Third, there are literally hundreds of ideas and developments in CAL which fall short of requiring sophisticated computer programming competencies. Many require little more than entering already printed lines into the storage of the computer and executing the load and run commands.

Turning back to ideas regarding CAL development in geography, I have selected examples representing CAL in the matrix (table 1).

A stand alone CAL program may represent programmed instruction, basic drill, or skills development essential to implement other learnings. They are, however, totally self contained as an instructional unit. Programs of this type are similar to "Nations of the World" and enable the user to master material through a question, response, reinforcement mode. While this is an important function of the computer assisted learning in geography, it certainly must not be viewed as the level at which the discipline should cease its CAL development.

Instructional assistance programs require that the material demonstrated or learned as a function of the computer fit into the instructions occurring through lectures, tutorials, worksheets, reading, or field work which occur as part of the curriculum. This is where a larger segment of geographical theory may be represented. For example, the comparison of theoretical to random to actual has always been a key aspect of theory testing in geography. This can easily be accomplished on the microcomputer by randomly placing land uses or economic activities on a matrix on the computer monitor. Patterns, distributions and relationships resulting from random location may be analyzed and compared. The spatial problems associated with randomness may also be identified and analyzed by the students. Quadrant or sector analysis may be completed either visually or by the computer. If a dot matrix printer is available, a hard copy map of the data may be prepared. If a printer is not available, a map may be traced from the face of the monitor.

This exercise may be followed by the selective location of land use or economic activities on the matrix. Students decide upon a development plan and allocate specific land uses to areas of the matrix. Zoning and/or cost prohibitions may be built in which cause the program to reject a land use decision which does not fit the student's overall plan. The results may again be recorded with a dot matrix printer or by tracing a map from the monitor. The random development can be compared to the planned development of the area, resulting in considerable problem solving potential regarding spatial development.

A third aspect of the exercise would include using one or more of the theories related to urban development: for example, concentric circles, sectors, and clusters. Again the students enter land use or land value data, but restrict their decision to a theoretical model. The results and analysis of problems may follow the same format as used earlier. It must be noted that the computer is being used to assist instruction throughout this process and printed material, map and aerial photo resources, and class discussion are all necessary in order to fully benefit from the activity.

The third area where CAL is beneficial is inquiry. These are generally rather complicated programming endeavors and usually require the assistance of a computer programmer. My first encounter with simulation was in 1973 when I adapted a version of RICEGROW (Houk, 1972) for use on the University academic computer. The result of that experiment demonstrated the positive benefits of CAL. That was followed by "The Game of Farming" (HSGP) which was written in an interactive mode. Both simulations were written prior to the introduction of the microcomputer and both required constant upgrading and changes as the academic computer underwent

modifications. Following those experiments, von Thunen's Model of Economic Rent was designed as a computer model and tested using experimental and comparison groups of students (Stoltman and Root, 1973). In retrospect, however, a comparison of the programming effort necessary for those programs a decade ago and the ones available today is encouraging in that contemporary program writing for CAL purposes can be accomplished by anyone with interest and patience.

The preparation of CAL inquiry programs in geography has focused principally upon simulation and problem solving. One example is Geography Search, which entails the participation by students in the search for a continent and a city of gold. The author of the program, Thomas Snyder (Olds, 1983) applied a clear idea of classroom needs to the design of the program. For example, the computer plays only one part of the simulation scenario and the students spend only a fraction of their time at the keyboard. This necessitates only one computer in the classroom. Second, the interactive elements of the program require students to work collectively on finding solutions to encountered problems. Small groups of students, with as many as five or six to a group, become the crews of ships that set sail in search of the new continent. The students must consider factors such as latitude, longitude, wind direction, wind speed, temperature, rainfall, ocean depth and the stocking of provisions for the voyage. The students do not learn information about an actual country during the Search simulation. They do learn geographical fact, concepts, generalizations and theories regarding the earth's physical systems. They gain an appreciation for how an understanding of the earth's physical system enables people faced with problems to use them in finding solutions. The use of geographic information in reaching group consensus and arriving

at the solution to problems is probably the most powerful attribute of Geography Search as a simulation. The author of Geography Search suggests that simulations in CAL be evaluated on 1) their ability to keep the complexity inside the computer, 2) to keep the learning at the forefront, and 3) to keep the computer in an obedient role where it belongs (Snyder, 1982, 36).

In 1983 we have little difficulty realizing the implications of CAL in geography instruction. We have, as a profession, only begun to scratch the surfaces of possibilities. At the same time we are on the verge of yet a new generation of computers. Program writing will become more manageable as the computer itself takes over a large portion of the process. Students with little formal knowledge of programming will be able to select options, enter data and analyze results without ever entering a GOTO statement on the microcomputer. Hand held computers little larger than today's calculators will enable students to connect data banks such as might be provided by the Information and Documentation Centre for the Geography of the Netherlands, or a similar organization in another nation, and investigate a range of geographical problems, All of this will be possible from the student's home telephone as well as the classroom. As teachers and the trainers of geography teachers we must prepare our students for those technological frontiers. We must combine the best material our discipline has with which to complement computer assisted learning and press forward to deliver it in an educationally sound manner.

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INSTITUTIONAL AND INDIVIDUAL CURRICULAR RESPONSES TO COMPUTER ASSISTED LEARNING IN NEW ZEALAND GEOGRAPHY

Pip Forer

Introduction

This paper focusses on the software adopted in New Zealand secondary geography and the forces that have encouraged, and continue to shape, particular patterns of use. Although focussing on New Zealand reference will also be made to progress in Australian geography.

The New Zealand education system operates a single, centralised curriculum and assessment system through its Department of Education. Geography in New Zealand begins in name only at fifth year although in substance much geographic education is subsumed throughout the secondary school under social studies and outdoor pursuits. At the start of 1983 the subject finds itself facing implementation of a curriculum (first outlined in N.G.C.C. 1978. Slater, 1978, O'Malley 1981 and Cant 1982 provide an insight to some of the issues raised by these proposals). In spite of the demands of existing loads (Keown 1980) and this oncoming change geographers have moved quickly to co-opt the power of the microcomputer. Setting aside generic users of educational computing, such as maths and computer studies, geographers are amongst the top four subject users. In a 1982 survey 10% of schools with computers used these for geography teaching. (Department of Education 1982a).

The use of school computers in geography commenced in 1977. Developments since then have seen adoption of imported software, small scale local production and a little commissioned production using a commercial software house. The

material that has emerged reflects various constraints and opportunities within the educational system. The paper describes these and suggests future paths of growth.

Computer assisted learning in New Zealand and Australian Geography, as in any context, is viable and justifiable only given certain pre-existing conditions both inside and outside of geography itself. Firstly it requires hardware, the nature and availability of which constrain the mode and contents of any C.A.L. presentation. Next it requires software support and training for its practitioners. Finally any given exercise can only progress within the confines of existing curricula.

These are the constraints. The dynamics of adopting CAL furthermore require (at first) a group of suitably endowed innovators and software authors and latterly, and perhaps more of a barrier, a wide pool of educators motivated to the introduction of C.A.L.

It is against these constraints that C.A.L. emerges and responds. The next sections look at how these constraints have affected use in one particular context: New Zealand Secondary Schools.

Institutional Constraint 1 : Hardware Provision

Neither Australia nor New Zealand had sufficient depth of terminal-based mainframe computing to gain entry to the early development of Computer Assisted Learning in the manner of the United Kingdom (with the National Development Programme for Computer Assisted Learning) or the United States (Wearing, 1975). Development has always been on small machines. Some of the earlier and more restrictive tutorial C.A.L. applications had even passed from high fashion before adoption was possible.

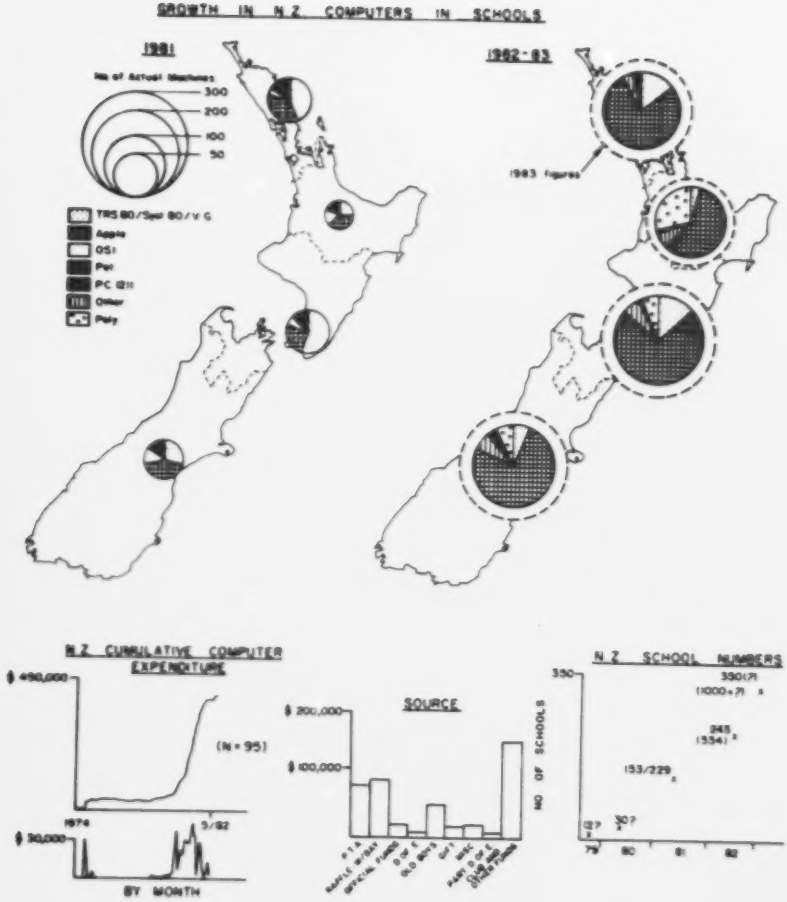
The main initiative for early development of C.A.L. in general secondary education came from two areas. Firstly the drop in mini-computer prices in the mid 1970s encouraged wider educational involvement in computing at a centralised level. This led the State of Tasmania to invest heavily in a Digital Equipment based terminal network to schools. This was, and remains, the most coordinated development of general C.A.L. in software has not been forthcoming. In a less centralised way a few wealthier schools, both state and private, purchased mini-computers. These began to attract attention from some availability of Huntington programs (public domain and distributed by DEC) proved significant in early CAL applications.

Secondly from about 1976 departments in various tertiary institutions began to purchase desk-top micro-computer systems. Of these two sources by far the most profitabe in the long run has been the second. C.A.L. in New Zealand and Australia has been essentially a recent phenomenom based on the microcomputer.

Any model of hardware provision for microcomputer CAL would probably identify five stages:

1. Isolated machines in a few schools and tertiary institutions.
2. General possession of a single computer by all schools.
3. Multiple Units in Schools.
4. Networked Multiple Units (intra-institution).
5. Globally networked units linked to public telecommunications.

In spite of relatively high hardware prices (figure 1) Australia and New Zealand are now passing from stage 3 to 4. For New Zealand the detailed chronology is extremely compressed after stage 1 which dates from 1974. Phase 2 really only emerges in mid 1982 and phase 3 in late 1982. Tasmania retains its central


GROWTH IN N Z COMPUTERS IN SCHOOLS
1981
1982-83
1983 Figures
300
200
100
50
TRS 80/Spot 80/V G
Apple
OSI
Pet
PC (IBM)
Other
Poly
N Z CUMULATIVE COMPUTER EXPENDITURE
$ 490,000
(N = 95)
1974
5/82
$ 30,000
BY MONTH
SOURCE
$ 200,000
$ 100,000
N Z SCHOOL NUMBERS
350
390(?)
(1000+?)
345
(554)
193/229
127
307
79
80
81
82

computer facility but increasingly uses it, along the lines of the Hertfordshire experience, to coordinate largely autonomous school microcomputer units. In Tasmania this amounts to over 100 terminals and, in total, several hundred intermittent remote devices. In New Zealand only the Rotorua High School Board has adopted this approach.

The infrastructure for moving to stage five, extra school communications, is emerging. As yet neither nation possesses full Video-test or Teletext services but these are in train and an Australian version of The Source data bank has been active in Australia since 1982. It will commence in New Zealand in 1983.

Current CAL is therefore, at the start of 1983, practiced with single-system oriented teaching units, minimal inter-user interaction and restricted data storae on floppy disk. This is likey to be the dominant available mode until 1985.

The hardware situation in New Zealand and the various states of Australia varies a great deal (Moore 1981). The dominant machine has become the Apple II. It is the standard machine in most Australian States and the de facto standard in New Zealand. The ageing architecture of this machine has led to a growth in interest in the BBC Computer. Three states and the New Zealand authorities have it on their list of approved machines and Western Australia has been very active in developing marketable software. Substantial minorities of other equipment also exist, particularly in New Zealand. Because of the relatively high demands geography C.A.L. can legitimately make on computers not all of these machines are suitable for further software development.

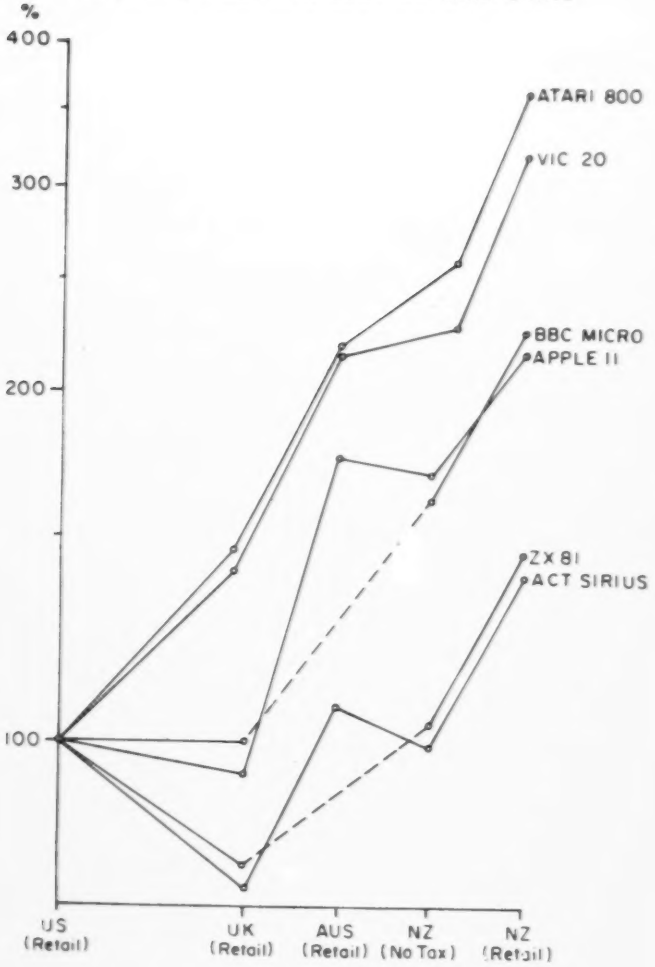
The actual 'in the classroom' situation varies enormously from school to school. Melbourne Grammar has a local area network of 100 machines and many have less ambitious networks planned or in place. By contrast small and rural schools may have no machine or simply one to be used as an 'electronic blackboard'.

New Zealand provides an interesting example of the significance of hardware adoption on the development of computer assisted learning units in geography. Initial computer purchase centred on CBM Pets and TRS-80s imported from about 1979 and which dominated the market until early 1982 (figure 2). Aggressive special-offer marketing sold at least one Apple to every New Zealand secondary school in mid 1982 and changed this balance considerably. Further offers led to a second or third Apple being sold later that year to most schools and the establishment of the Apple as the 'de facto' standard educational computer.

A government initiative in 1981 had meanwhile sparked the development of a New Zealand designed system specifically for education, the Poly-1. This machine is a networked microcomputer with teletext and colour graphics facilities using 5 superimposable screens. Its robustness and graphics far surpass the Apple II. By 1983 this had found purchasers in about 30 (8%) of New Zealand secondary schools. It was widely rumoured in 1981 that a programme costing up to NZ$10mn was to be funded to provide this system universally to all schools and to support its implementation. We shall return to the Poly 1 because it formed the basis of a concerted attempt to develop centralised school software in geography. It is also the only machine currently tied in to a centralised coordinating facility in any area. The Rotorua High Schools Board employ Poly systems in their schools linked to a central PDP processor.

The only advantage of this variety is as an objective lesson in conditioning of CAL authoring style and content by machine capability. With the Apple II the programmer is limited by the vagaries of its colour system and problems with text on the graphics screens. With the Poly we have found that an identical instructional unit will be presented differently due to the ability to display up to five, superimposable screens. Priority overlays, masking, simple text prompts and so on allow a far more sophisticated presentation to emerge. Translation of software to the BBC machine can be inhibiting due to its single

FIG 2. THE RELATIVE COST OF COMPUTING



screen. Long planned software (including some Landsat simulation exercises) is at last possible however only on this machine due to its truly bit-mapped graphics.

This conditioning may, as in the last example, restrict certain applications. More commonly the aim of a projected unit will remain unaltered but its precise presentation and impact affected.

Several Australian states suffer the same problem of diverse machine types. There are several 'approved' machines over the entire system including the Apple, BBC machine and the domestically produced and more limited Microbee. In so far as geography CAL is a graphics-oriented medium the constraints posed by particular system-wide choices of equipment are not inconsequential. Geographers, more so than most users, are best served by technically advanced machines and conversely more disadvantaged by split markets and low software portability.

The Institutional Base: Support and Software

The problems of running different microcomputer systems are compounded by a lack of institutional support for the authoring of suitable geography software. This section will be brief since by and large the problem is self evident and measures to counter it in Australia and New Zealand so minimal that little splace can be profitably filled.

In general the production and dissemination of geography software has fallen on the shoulders of a legion of part-time enthusiasts. A few individuals have acted to purchase or disseminate useful software. In some Australian states quite efficient clearing-houses for school software have emerged. In one or two a central authoring facility exists to respond to teacher requests.

What has emerged from any centralised involvement has been from two sources.

A small, professional, well documented flow of general software has come from the few full-time Australian programers. Due to the inherent pressures and priorities geography seldom gets a great output from this source but some good units are emerging. Western Australia is marketing useful fact acquisition material for the BBC computer on Western Australian Resources.

In New Zealand local and central government response has been minimal. The main instrument for CAL promotion has been the New Zealand Geographical Society, both through a Geography Resources Centre (based at Christchurch Teachers College) and its Working Group on Computers in Education. However, the two most used classroom geography units have come from quasi-evaluative exercises on the computer funded centrally. One was a set of 16 programs undertaken to evaluate the Poly and classroom reaction to it. The other was a minor and earlier project aimed at evaluating the Apple graphics capability with minimal reference to classroom application. (Forer and Stokes, 1980). In general software dissemination is improving but is often informally networked. Support for teachers has beenminimal. Most teachers are either enthusiasts or way. A clear example of how the wary can be converted with great effect is given by Green (1983). In General little encouragement is given and secondary teachers continue to underestimate their own capabilities in this area. Training for computer applications has ben under way at a low level for some time but is insufficient in scope. Issues of style or documentation, as addressed by Wells (1982) or Burkhardt and Frazer (1982), have simply not been widely considered.

The Institutional Base : Curriculum Options

The interaction between the curriculum and educational technology is a difficult area, particularly when the technology is as powerful, changeable and unevenly available as school computers. In New Zealand it raises particularly penetrating questions since New Zealand geography is undergoing a major reorganisation of its curriculum. Initially there are logistic problems : who has computers

and what software is available. The situation in this respect has already been reviewed. Then there is the wider concern of desirable curriculum content. A major problem is the contrasting development time for design and implementation of curriculum reform (a decade perhaps) and the availability of new technology (currently making very rapid quantum leaps). For instance the time for all New Zealand schools to acquire a computer or to acquire a network or, when it comes, video-disk equipment, represents a period of perhaps one cycle of consultations in curriculum design and implementation. The curriculum to be adopted by New Zealand schools in a year or so was initially conceived when perhaps 2% of schools had a single computer. It will be implemented when over 50% have class sets. One aspect of this reflects that the problem of lead time in software provision. (the specific application of Murphy's Law that states that good teaching software is always released just as the machine it was designed for becomes obsolescent). Curricula require flexibility as their only possible reaction to a fast-changing technology that : alters the scope of material that can be covered; questions the apportioning of teaching afford and methods in various areas; and transforms society's views of what are valuable skills for education to provide.

Outside of geography the need to consider the impact of computers in education in all aspects of the school curriculum has been recognised by both teachers and the Department of Education. At their 1981 conference the high-school teachers body, the Post Primary Teachers Association (PPTA) recommended a considerable increase in the monitoring of curricula, both at a school level (recommendation 4.5 iv reads that to this end the Association should urge other organisations responsible for curricuum development and assessment at national levels to review their programmes to ensure that changes arising form the new technology are taken into account.

In its one, circulated statement in the area to date the Department of Education's own Consultative Committee on Computers in Schools (Department of Education1982b) makes similar recommendations. These included recommendation 5

> A regular review of all school subjects should be undertaken to ensure that they involve appropriate elements and are so structured as to reflect technological change.

and recommendation 8

> Syllabus Review Groups should include wherever possible at least one person with a background of computer experience in the subject under review.

In these regards however New Zealand geography pays the costs of already being under current curriculum review. The structure of the curriculum is already set. The consolation is that curriculum outlines are in purpose strategic documents while the impact of educational technology, at least initially, reflects more tactical issues. If the high level strategy is sufficiently flexible then positive tactical initiatives can be safely adopted. What is the nature of the new curriculum and how can it adapt?

The geography curriculum currently in New Zealand schools covers high school form 5 to 7. It is a fairly traditional syllabus with an emphasis on accreditation by examination and limited local input or control in the topics covered. It is nationally coordinated by single national bodies at all levels. A healthy stream of teaching outside of the examination context exists for certain pupils (Leach 1981) but this is not a major phenomenom.

The current syllabus has been attacked from various angles. One criticism is the requirement to teach regions which now seem irrelevant to New Zealand at the same time ignoring significant regional studies. The Physical/Human balance has been criticised as too light on physical geography in a society

where man/land issues are central. Another point has been the low amount of local autonomy afforded in syllabus design and examination, although extensions to field work options have now ameliorated this. The current curriculum permits a limited amount of experimentation but defines fairly clearly the way in which class time might be used. The contents as such are not especially facilitative to computer applications in those areas where a case for early adoption might be made.

The new syllabus differs in various ways. Although criticised by some (c.f. O'Malley 1982) it has drawn support from many areas. It provides for a more flexible approach to teaching employing as central concepts an ideas bank and a concept bank. In general two particular trends are embodied. Firstly a far greater freedom exists to the individual school and far more assessment is undertaken locally. Up to one third of the syllabus can be tailored around specific local community needs and local projects are further encouraged. Secondly the teaching of a particular topic has been given much greater freedom in spatial context. Thus the teaching of the geography of a large city (over 1m. inhabitants) was previously only implied within the specific regions prescribed. It now appears as a topic in its own right for which the teacher can choose the most relevant spatial setting.

It is plain that the perceived teaching requirements of a course greatly influence the degree to which a CAL unit will be assimilated into a course. The current syllabus leaves only certain options open. The need to marry available software to specific teaching topics frequently restricts what can be utilised and this comes through quite strongly in the last section of this paper.

The new curriculum makes no overt assumptions on the role of CAL but it offers more scope for two reasons. Its flexibility is such that existing software

is more easily assimilated. This is particularly so with software written to develop concepts and ideas in a fairly abstract fashion that is not place-specific. The corollary however, raised by O'Malley (op cit) in respect of textbooks, is that the local market for material that is actually place-specific will be reduced by splitting.

The increasing emphasis on local projects also further opens the way to using the computer as an analysis tool and to using the wider data bases of an emerging information-rich society. These are not skills unique to geography but are of especial relevance to it. It also opens the way for handling specifically geographic computer uses such as computer mapping (with all the subsidiary considerations that that can involve). It is, then, a facilitator of more effective CAL applications rather than an innovater. In a world of rapidly changing innovation that may be, in fact, the best position for curricula to adopt.

In practice it is necessary to separate the idealised curriculum from the practical possibilities. The great practical hinderance to any rigidly specified CAL in any geography curriculum is the dearth of sound software. The effort to obtain hardware is minimal compared to the planning and effort to provide good software and naturally curriculum planners are loath to design a curriculum involving areas that may not be universally serviceable by all schools and may depend on the authoring of instructional software not presently available. The situation is a vicious circle to some degree since software will only appear if a market and educational niche exists for it. What may occur, and is already occurring in New Zealand, is the solution of this impasse by the commercial sector which will provide educational experiences, often not of a totally desirable nature, to a growing band of home-computer users.

The new curriculum in New Zealand invites the use of existing software to a grater degree. The freedom allowing this however is also the freedom that reduces the size of market that any unit can service. When compounded with the variety of machine types available this is a not inconsequential problem. Furthermore, although the autonomous time in the new curriculum is far more flexible there may well be less flexibility in reality in implementing more substantial computer-based themes within the body of the curriculum at large.

In summary the new curriculum in New Zealand can be criticised for its lack of recognition of possible computer applications in school geography. There are areas which are relevant where the computer can make a better contribution to high school work than is recognised. Learning about satellite imagery through the microcomputer, in a country of low population and large natural resource, is a case in point. This is an important area, too ambitious to develop from one school and yet not likely tocome to the classroom through the current proposals.

Potential computer impacts on the new curriculum was not a concern in curriculum development as is chronically plain in the 'G' series support material being put out by the Department of Education. No significant computer support material is provided in the numerous volumes of this series. A major contribution that the computer can make is to facilitate student-oriented learning skills rather than teacher oriented delivery. This potential is perhaps yet to be fully tapped by the curriculum as so far developed.

However, it will be an interesting curriculum to watch as it develops at the chalk face. It does have the flexibility to respond and incorporate a growing use of computer assisted learning. The pattern of adoption will reflect local initiative and concern as much as any central direction. This may prove a good test of the newly-granted, local curricular autonomy.

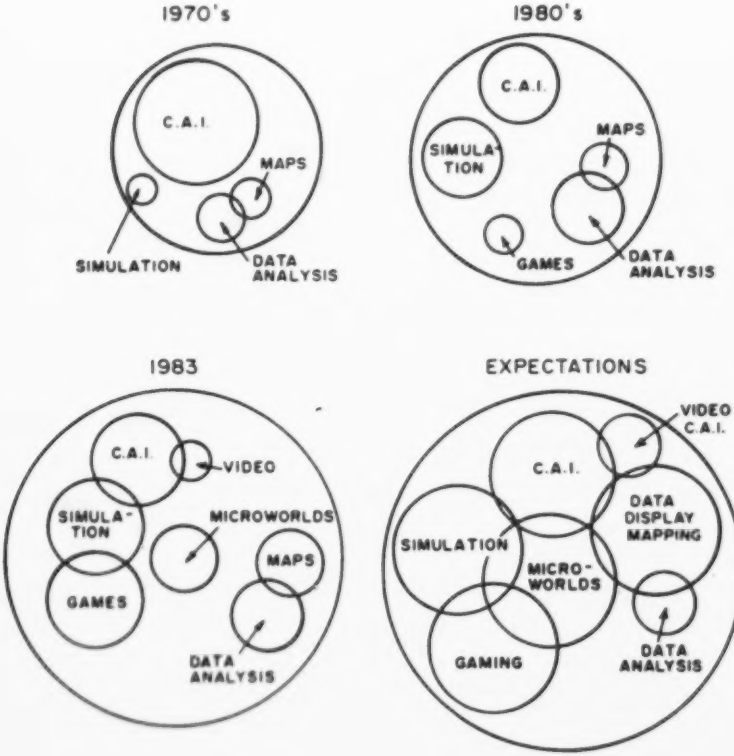
The Individual Response : Patterns of CAL Authoring and Adoption

Against this background it is possible to trace the adoption of various CAL units over time. It is interesting that, while the initial CAL software was imported from overseas, by and large imported material has not been used to the expected degree (even though knowledge of its availability has grown considerably over time).

The general perception of computer assisted learning in New Zealand geography has changed over time, as figure 3 attempts to portray. Initially CAL was mainly perceived as a series of isolated approaches in which tutorial CAL loomed large. Practical experience led to a wider appreciation of alternative modes and by 1983 a more critical and sophisticated reaciton to CAL capabilities could be discerned among practitioners. At the same time developments in computing at large suggested that the isolated modes of CAL were beginning to overlap and intermingle more completely and that multiple-mode software would be the likely direction of greatest future potential.

The first geography unit to achieve use in school was probably the POLUT unit from the Huntington II suite of programmes, used at Christchurch Boys High School in 1977. (Duckmanton 1979). This unit went on to achieve wider use and became popular in several schools (cf Chalmers 1980, Keown 1980). At about the same time HMRABI and SMOG, obtained from other sources, also became popular. (POLUT is a simulation of water pollution, HMRABI a well known resource allocation game and SMOG a very simple example of air pollution simulation). The original, innovative school operated a small DEC machine. This had spare time available on it and the POLUT unit was used by the geography master, who arranging for the program to be run at times independent of the time spet by the class on the exercise.

THE PERCEPTIONS OF THE SIGNIFICANCE OF MODES OF C.A.L. IN NEW ZEALAND GEOGRAPHY



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Through the work of the Departments of Geography at Canterbury and Waikato Universities these and other programs were translated to other machines. Most significant was the Waikato translation to the TRS-80 machines that enjoyed a brief dominance in early school use.

All the three programmes mentioned above are simulations. The reason for the popularity of POLUT in particular is clear. For a start it was cheap and superbly documented. The teacher could use a unit with little additional research beyond the supplied documentation. This was a necessary but not sufficient condition for use. The equally endowed MALAR and BUFLO from the same package were little used. Even the excellent LIMITS simulation of the Club of Rome model attracted few takers. The real attraction of POLUT was the easy with which it could be linked in to the existing curriculum. POLUT related to existing teaching in some schools and could also, by the collection of data from real water bodies, be plugged in to field work and the context of local problems. It was even easy, through the users' guides, to modify the program for local spelling usages. Such vacant niches in the curriculum were rare, particularly given the limited recognition of geography in the United States education system which was the source for the bulk of existing material at that time.

It might have been believed that British material offered an alternative software source and indeed an early link was made with the Geographical Association Package Exchange, funded under NDPCAL during the 1970s. However the material there suffered from its mainframe orientation (and lack of classroom applicability to the subject as taught in New Zealand. This latter reaction was a blend of different curricula and of the differing availability of classroom equipment in the two countries. More recently Computers in the

Curriculum units have raised interest but they too have raised problems with local implementations.

As a result of increasing interest and availability of microcomputers in New Zealand locally authored software emerged from two sources. The first of these was based at the University of Canterbury and involved an assessment of the Apple II graphics capability. The result was a series of four programs, titled the New Zealand City unit, which addressed certain aspects of urban form and growth. (Forer and Stokes 1979) One programme simulated the growth of a city under different mobility assumptions, another allowed the drawing of simple bid-rent curves, a third simulated land use under zoning restrictions and a fourth provided a retail simulation between two players using paddle interaction with the screen. Although not specifically designed for classroom use these programs have since been upgraded and have proved popular and have bee translated under contact for use on the Poly system and distributed in Australia. (Figure 3).

In general the N.Z. City units have been designed with the idea of allowing the user to discover the property of certain models or processes by experimentation. Their popularity has come from the fact they were initially available free in New Zealand (if skeletally documented) and again can be related to the existing syllabus. They can also be used easily in an electornic blackboard mode with one teacher acting as intermediary in a class investigation of the models and do not need (though they benefit from) a printer. They have also had the good fortune to be produced to utilise the graphics potential of a machine that has become the de facto standard in New Zealand. Psychologically interesting is the fact that teachers appear to dismiss software that ignores the machines full capability. (so HMRABI has waned in

popularity with requests for a graphics-based version) and respond well to 'local' software. This observation is based on the contents of New Zealand City, which are blandly international in concept. The local image comes from a few, well-placed mentions of local examples, not least the title.

The second development has been the far more ambitious creation of a suite of geography units for the Poly computer. An original set of over 60 programs from 8 disciplines were planned to allow in-school evaluation. To create these serving teachers were seconded to specify the sort of material needed and these liaised with professional programmers from a New Zealand software house, Progeni. The exercise was condensed and costly but produced some interesting geography units. (significantly perhaps, 20% of the original programmes developed were geography units, Polycorp 1981). In part these, like the Apple exercise, were designed to test and display the graphics capabilities of the Poly and certainly little revision of the units after classroom exposure has taken place. The units were largely CAL units designed for fact acquisition (Table 1) although at least one unit was presented in a game format. It is interesting to note that teacher reaciton to these units has not been unanimously favourable. In part some have simply claimed that the level of pre-existing knowledge required is too high and in-program assistance too small but in general the reaction appears to stem more from the inquisitory mode of delivery as much as anything. The Poly system's availability in schools has limited the spread of this material into schools. This question of limited numbers of systems has tended to slow software development on Poly although experience suggests that the equipment is well suited to some very interesting developments.

TABLE 1 - units Developed Under the POLY-1 programme

Units	Title
1,2	Canterbury Locations Drill
3	Canterbury Plains Formation (Diagrams and question and answer of the processes that developed the Canterbury Plains)
4	Climograph Construction
5	South Island Relief and Climate
6	Canterbury Physical Patterns (Relationship of physical elements of the environment).
7	South Island Transect - Examines various physical and human aspects along a transect.
8	Introduction to Geosystems
9,10	Farm Systems CAI
11	Farm Plan Interpretation (simplemap skills)
12	Farm Decision Making Exercises
13	Topographic Map Reading : Skills Test
14	Developing Graph Skills
15	Land Use Models, Von Thunen explored in the context of the Canterbury Plains.
16	Demonstration Maps.

The third source of software to come into secondary education has come from tertiary institutions. Research data and programs have lent themselves, in an edited form, firstly to tertiary laboratories and latterly to diffusion to schools. Thus a facility mapping program has been produced that allows the recall and plotting of urban facilities. This links to questions of access and social equity and in practical terms to local field studies. Equally a simulation of a South East Asian peasant's family life (Johnston 1983) and an investigation of regional patterns of unemployment have found their way into limited application. The commercial landscape mapping package, Topographic Mapping has also diffused.

These sources are now being increasingly supplemented by local teacher initiatives. The work of Green (1983) is a case in point where adventitious software has sprung from the school level. This kind of development is severely hampered however by lack of central support with a totally inadequate response by educational administrators to the time required to fully debug and document any application.

In brief summary geography teachers have warmed to discovery-oriented material, suitable(where necessary) for electronic blackboard style of delivery. They have shied away from material they suspect merely reinforces the teacher's imposition of a rigid learning strategy : hence the strong preference for simulations and field-related exercises. How the future balance will sit is harder to gauge. More intelligent tutoring, such as the language PROLOG may afford, may make tutorial CAL more capable of providing good instruction.

From an alternative perspective we might propose that software is of three types. The computer as Teacher is essentially conservative in its impact

on curricula. The computer as Vehicle, involving student control, is more liberal and likely to have greater impact on the curriculum. The most pervasive and largely undocumented, mode is the computer as Medium. Working through the practices of the every day world and appearing independently of specific educational software design this force, typified by microcomputer-based Prestel emulators, may turn out to be the most significant impact on the curriculum, and on teachers' reactions to it.

It is expected that the arrival of the BBC computer in New Zealand in numbers, with consequent cheap software, will lead to a wider availability of certain types of instructional units, particularly of the capes and bays variety. This raises an extra issue : the role of non-institutional geography CAL. Here equity and appropriate teaching techniques are two major issues and it is plain that a possibility exists that the formal educational system will find itself to some degree outflanked. The response of geographers to this development is a significant question.

New Directions

This paper has described the development of CAL in New Zealand geography as a set of pragmatic responses to opportunities conditioned by constraints. That is not good educational theory, or maybe practice, but it is what is happening on the ground. The computer opens too many doors too quickly and with insufficient public sector response to allow for orderly development. Development will occur however, either from local initiatives or from adaptation of overseas ideas. Tasmania has produced an interesting unit (historico-geographical in nature) called 'The First Fleet Data Base' which allows the interrogation of facts about the first (enforced) emigrants to Tasmania. Almost every State and every region of New Zealand has its 'First Fleet', albeit with differing social characteristics. One can see this exercise being

a typical blend of portable concept and local data base.

In New Zealand it appears that CAL has an immediate and clear future in exercises involving field work and data acquisition. Undoubtedly this will evolve into a wider use of telecommunicated data sources. On the other hand exercises in which CAL is more removed from field work and data description and is more related to communicating thinking skills of a wider sort tend to have a less clear path. The main projects of an innovative nature being planned focus on a movement away from the electronic blackboard or the lone microcomputer user. They relate far more to augmentation of the basic computer; with video imagery or by computer networking. The aim is to design software for the future needs and equiment base of education. (surveys such as Ruggles et al 1982 or Duke, forthcoming, indicate both the potential of the equipment and the lack of application development, especially for video equipment). In the former case (video) the proposal is to use computer-controlled video imagery to assist in the acquisition of map interpretation skills. Since both New Zealand's landscape of maps are unique this is a project necessitated by local conditions and with little overlap with developments elsewhere. With networks the hope is to produce a multi-player simulation of regional growth based on an earlier microcomputer game, Sisun (Forer 1977). The aim of this is the creation of a self-contained microworld along the lines of Dwyers Solo/NET/works project (Dwyer 1981). In this case though the exercise would be based on a single machine type in a network. At present the equipment is yet to be widely available for the delivery of such an enterprise in the classroom. However one suspects that the lead time for development of such an exercise is somewhat longer than the most likely arrival date of widespread networking.

This paper has concentrated on New Zealand developments. The pattern in Australia

is structurally the same. Computing equipment is cheaper, money is a little easier toobtain, but funding for skilled personnel is still insufficient. The result is very small pools of high-quality work in various areas but no coordinated developments to match the pace of technological change. Internationally and domestically the coordinated provision of geography CAL software is missing. Software needs to be seen to be appreciated but, for Australasia at least, is often not lcoally available for assessment. Software is, after all, both complex in itslef and complex in how any given teacher can relate it to his teaching practices. The experience with bought-in commercial software has not been a happy one. What is required is a deeper international interchange of experience and material. How this can be bought about with the considerable problems of inter-machine portability and curricular differences is another matter.

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PALAEOTECHNIC IMPRESSIONS OF COMPUTER ASSISTED LEARNING IN THE UNITED KINGDOM

D. B. Hall

INTRODUCTION

This paper seeks to achieve two purposes. The first is to describe the structure through which Computer Assisted Learning is being introduced into the school curriculum in the United Kingdom. The second is to indicate the extent to which the microprocessor has penetrated the geography classroom at the present moment in time, and to offer some comments about it.

These are early days. The software currently in circulation is the concrete expression of a dual inheritance: one cluster of titles can be traced back to the era of the mainframe computer and a view of the subject which is strongly positivistic in outlook[1] - such as SPITSIM and TRANSPOTS for example, - whilst a second cluster has lighter documentation and draws upon the images and sounds of the game arcade, the chained sequences of programmed instruction (e.g. HURKLE). In each case the pupils' role is external to the process. In the first case in relation to the program he acts as an operator of a black-box programme, and in the second he becomes the object for operant conditioning.

In such circumstances, impressions about computer-assisted learning are the product of palaeotechnic forces. We are as yet unable to articulate ideas for programs in which computer technology is used as a powerful instrument able to engage the imaginative insight of the learner through the combination of Jerome Bruner's three modes of representation at its disposal: the enactive through the use of transitive objects, the iconic through dynamic graphics, and the symbolic/interactive through the use of new computer languages created to integrate and enhance the learning process.

FUNDING AND HARDWARE

Let us turn to immediate realities. A review of developments in this country will seem disjoined and confusing to an international audience unless we are reminded that the diffusion of responsibility for curriculum is the distinctive structural feature of our educational system. In terms of funding, it is a national system locally administered. Policy of central government is indirect in its effect. The release of £4 million through the Department of Industry for the purchase of microprocessor hardware in secondary schools, shown on the left hand side of Figure 1, was unprecedented, but had to be matched by money raised either through the local authority or by the money-raising efforts of individual schools. It was also controversial in specifying a choice of only two designs (380Z of Research Machines of Oxford and the BBC/Acorn produced by Acorn Computers of Cambridge) to a specification agreed with the British Broadcasting Corporation originally intended for use with an audience of listeners to a programme series on the microcomputer). At the time of the announcement of the DOI initiative in 1981, some local authorities had already recommended alternative makes of machine to their secondary schools, and had assisted interested responders with funds for this purpose: in the North-West, for example, the 380Z, The Commodore Pet, and the Apple were adopted by neighbouring authorities. Figure 1 attemtps to show this variety, but it should be emphasised that the effect of the DOI funding has been to put the 380Z and the BBC/Acorn nationwide into the greater majority of secondary schools, and there is no doubt that software development is taking due regard of this fact.
Many schools have also disbursed funds raised by Parents' Associations and other fund-raising events - including competitions sponsored by Banks, - to purchase addtional microcomputers and peripherals: there must be about 10% of schools with computer rooms and an assorted inventory of microprocessors set out in the image of a language laboratory. Where this

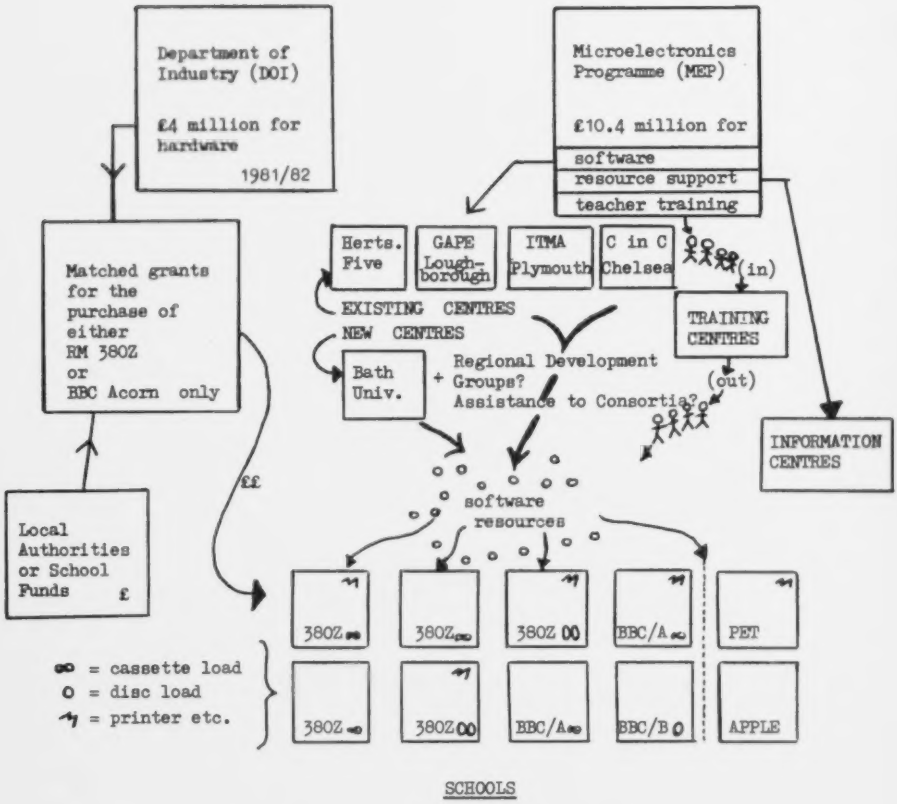

Figure 1 The funding structure for the introduction of Computer-assisted Learning in Secondary Schools in England and Wales.

growth has occurred, the tendency has been to buy a variety of machines rather than risk investment in one type of machine only. This is likely to have been an error. When the DOI scheme was extended to Primary Schools in September 1982, the simpler sister machine RM480Z was specified with the BBC/Acorn as the alternative. Thus although the robust RM machines are in a strong position, I would predict that the future lies with the BBC/Acorn model B, purchased with disc drive and econet interface. A further £3 millions has, in Spring 1983, been made available for Secondary Schools to update their RM380Z, or their BBC/Acorn machines with disc drives, increased memory, and colour monitors, and with peripherals such as printers, electronic measuring instruments, and floor turtles.

What is even less easy to anticipate is the effect of the promotion of the Sinclair ZX81 and similar low priced machines to the home purchaser on the types of program and on pupil and teacher attitudes to CAL in the school situation. Nor do we know the extent to which the average family will trade up to the next level of hardware (e.g. the Lynx, the Dragon, and the Sinclair Spectrum) or whether geography teachers will buy these more versatile machines for home use and produce a new range of programs from them in their leisure time.

This thought moves us to the right hand side of Figure 1, away from the DOI's promotion of real estate to the initiatives of the Micro-electronics Programme (MEP). This parallel programme set down its strategy in a document published in Spring 1981[2]. The aim was "to help schools prepare children for life in a society in which devices and systems based on micro-electronics are commonplace and pervasive". As written, the document is difficult to unravel, so I have summarised the rationale in Figure 2. It shows that the budget of £10 million plus fell under the three major headings of resource support, in-service teacher training, and curriculum development. But the amount of money, when broken down under these headings and then shared out between each of fourteen regions is quite small: on average there

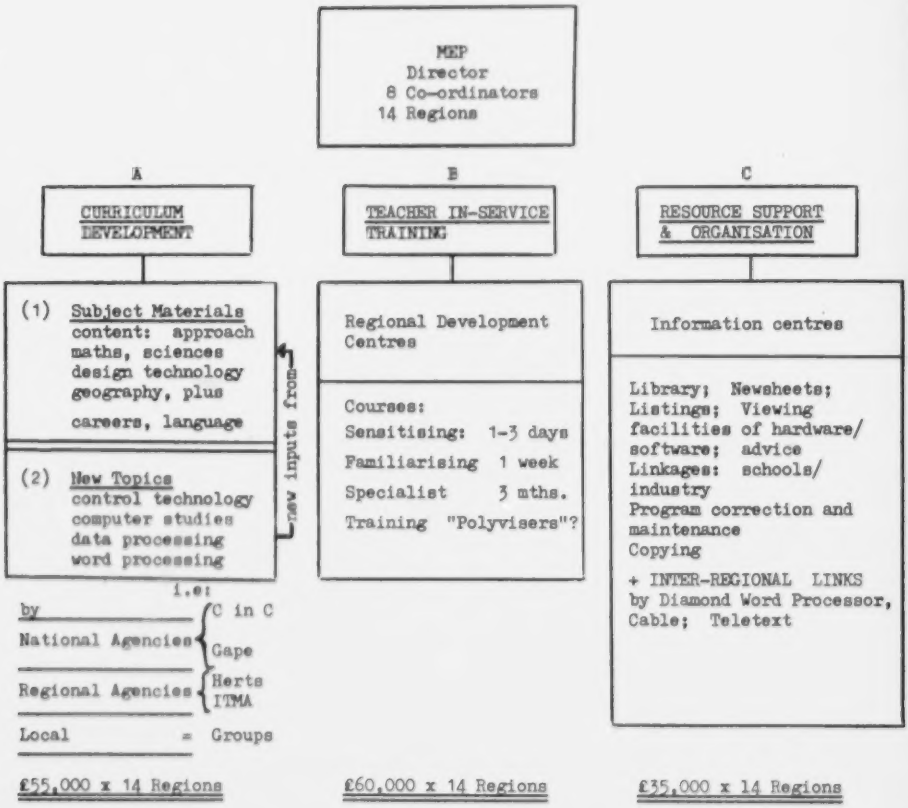

Figure 2 Strategy for the MEP Programme : March 1982

are 350 secondary schools in each of the fourteen regions, each school might therefore indirectly expect to benefit by some £100 plus per year by the consumption of services either at a training or at an information centre. The budget is in essence a trigger mechanism by central governments and the financial burden of any significant effort to train, innovate, and support will be borne by the local authorities(3). We can therefore expect great differences, in spatial terms across the country, according to the willingness of the local authorities to provide funds, possibly at the expense of other activities. And, we are talking about resources for which geographers must compete with other established subjects.

Under the first heading, resource support, all fourteen information centres are operative. In the provinces, the MEP regions are impossibly large (the South West runs from Tewkesbury to Truro) so that visits by class teachers to their "centre" are virtually impossible unless it is fortuitously close by. Programs, for example, can only be viewed on site for reasons of copyright. One can write in for details of courses, or for a listing of geography programs and each region produces a newsletter about once every three months. Geographers in Staff Rooms rarely seem aware of it. One can write for listings of Geography programs. The Southern and the South-Western Region listings differ and the amount of information given is insufficient and unreliable (i.e. in terms of availability, format, and cost) and there is no package evaluation to help the interested teacher to make choices. The pressures and demands placed on the highly committed professionals at these centres are intense. They are not subject specialists, but computer experts. In geography, the programs transmitted by landline to the centres from producer sources, as at Hatfield, have been withdrawn, while their sponsors or authors rewrite, debug, and then redistribute them through commercial publishers with their rights to royalties protected.

IN SERVICE EDUCATION

In-service training is another problem area. The original idea in the Strategy Document is shown on the right hand side of Figure 1; training centres" would be established in parallel with "information centres", serviced by personnel contracted out part time from institutions such as the Polytechnics and Colleges of Education. What has happened is that places with pre-existing expertise based on curriculum development (such as ITMA/Plymouth; Chelsea, and Five Ways, Birmingham, which I shall discuss later) have been asked to deploy some of their energies in this direction. Under these limiting conditions, schools have been invited to send just one representative teacher to intensive weekend courses which were pitched "across the curriculum", with the idea that each would return to his own school and act as catalyst amongst the staff. You can imagine, even if you have not undertaken a detailed study of diffusion theory using this model in the literature, the chances of this individual enthusing a large staff room in the cold light of dawn in a large comprehensive school, however ornate the certificate issued to him at the conclusion of his course.

There have been a number of courses for geography teachers promoted, in the usual fashion of our English system(4) by individuals who have access to the existing in-service apparatus of local authorities in Teachers' Centres, or in the Polytechnics, or the extra-mural departments of University Institutes. The Bristol Region has probably been more active than the average, with a number of "awareness" days or afternoons. But these events are not a serious attempt to train; even three days was considered insufficient in the strategy document (see Figure 2). Bristol Polytechnic has underwritten two courses in 1981/82 of six evenings in response to requests from the local Geographical Association. A number of weekend residential courses have been sponsored by the extra-mural Department of the University, with a national clientelle. We have just run with Bob Barr as anchor man,

a more ambitious three-day course for 30 geographers, determined to get away from the limitations of one-day stands, involving much more hands-on experience, local teachers, and pupil demonstrations. Bob Barr is to talk about in-service himself, so I will only say that we planned the course a year ago deliberately in the expectation that a much wider range of software would be available this Spring, which would guarantee a successful outcome if we did not bungle the sessions. In fact, the evaluation outcome was strongly favourable, but not thanks to the available offerings of the publishers, many of whom have ambitiously listed programs before they are available for distribution.

SOFTWARE

This brings us back to the third heading of the MEP initiative, that crucial area of the development of software and documentation. Our 1981 survey(5) repeated in 1982 revealed that only a handful of programs were in use, particularly FARM, MILL, MORPHO, DEMOG and HURKLE. I will run a videotape of my colleague at Backwell School, Bristol, Philip Webster, using MILL with a mixed ability class aged 14 years, which will convey effectively the productive use an experienced teacher can make with such programs. I would at the risk of standing corrected by Deryn Watson in this audience, be far less confident about its success with a teacher who lacks the technical knowledge about the computer possessed by Philip, even if he has the classroom skills to match Philip's thoroughly professional performance. It also highlights my opening remarks of the palaeotechnic ancestry of existing programmes, however high their rating in the user charts of the "early adopters" I would not care to defend the theme of the programme, the principle of least cost location in Weberian terms, as of central concern to a multicultural society in the late eighties. But I would not expect teachers, many only recently committed to "new" (i.e. post-descriptive) geography, to agree.

Thus figure 1 portrays the symbolism rather than the reality of the MEP in this respect that a cascade of software would be released from the national and the regional groups, groups which largely predate the microprocessor with their origin in the days of the mainframe. The principal centres for innovation in geography: GAPE (Geographical Package/Evaluation); Chelsea Computers in the Curriculum; Five Ways at Birmingham; ITMA (Investigation on Teaching with Microcomputers as an Aid at Plymouth), and Hertfordshire/Hatfield are mentioned, and as many of their activists are listed in our Programme, their contributions are of great moment to us. In addition in 1983 the South West was also extremely fortunate to have Bath University procure MEP funding for what the policy document described as "new topics as elements within existing subjects". (see Figure 2). The project has in fact picked up the cross-curricular specification for "the use of the computer as a means of information retrieval from data bases" and applied it to geography. Gerry Hones and Ian Ferguson will expand on these initiatives. It is the only new centre which has received funds from MEP for curriculum development in geography.

DISSEMINATION

The whole tenor of this address so far has been to see the infiltration process as a matter of drip feeding from the centre to the periphery, albeit with Local Authority involvement and teacher discretion making diffusion indirect and ideosyncratic. It is the discretionary power of the individual teacher which acts as the counterweight to executive pressure and control, based upon the long cherished idea in this country of the teacher as fire-lighter, as the autonomous professional. Thus we can see change in terms of Carl Popper's vision of the fecundity of many individual nodes, exercising wisdom in decision-taking which sums to the general good.(6) Figure 3 shows therefore how decisions about Computer Assisted Learning arise: we have the Decision - shaping mechanisms dripping down from the centre from levels D to A, and individual teachers taking decisions, either at great risk by the

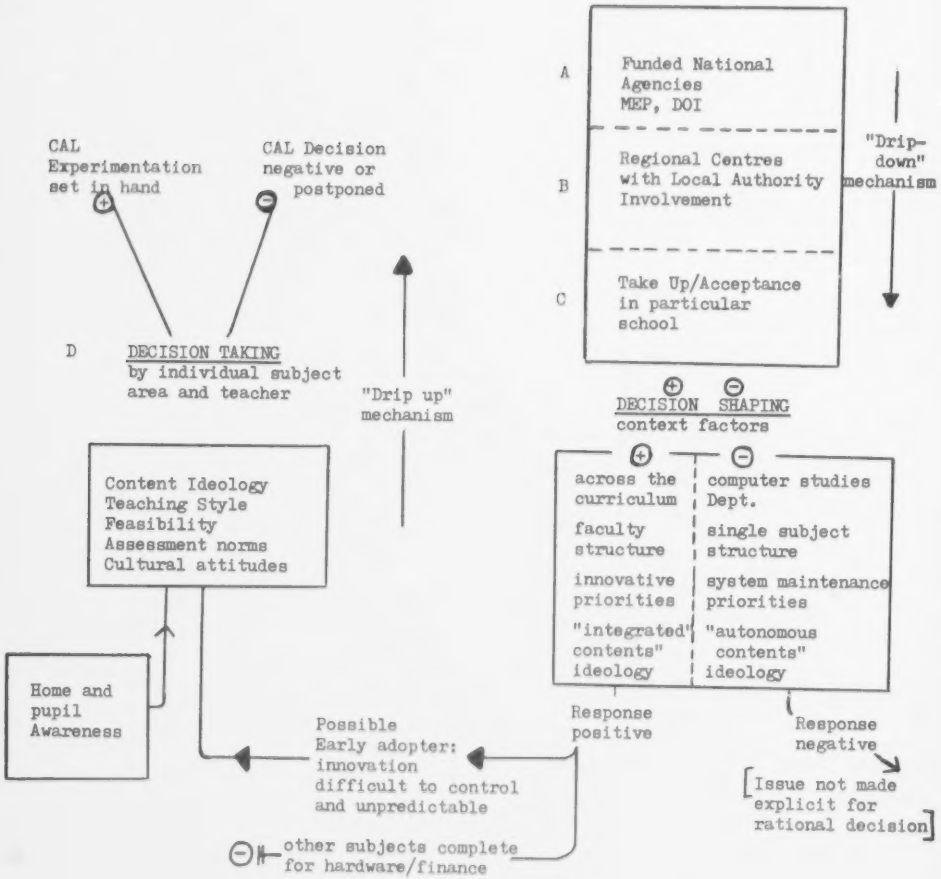

Figure 3 : Decisions : A critical path analysis.

entrepreneurial early adopter, or at little risk by laggard. The latter are unlikely to adopt CAL unless all points in the critical path are positive. The probabilities are low.

There are, however, alternative routeways for decision-shaping other than those which drip down from the centre. An alternative route is cultural, based on the home background of the school catchment and what children bring into the school from their community. Thus a teacher, unimpressed by Adviser, Teachers Centre, or in-service University organiser, may respond to cultural pressures, as a way of sustaining pupil interest in the classroom. There is some evidence of this in my own Region. Teachers have written short programs which interact with the learner to test their knowledge of city structure, or of cloud types. Knowledge of map symbols soil types, plate margin classifications, can all be tested in this way, or the content "knocked into" the pupil as it were by constant recourse to the program. Unlike the centrally funded projects, they are short, simple, and light on documentation. I mentioned my my opening remarks, that this inheritance has a long populist ancestry starting with the drill square and ending in the gaming arcade. Take, for example, a program devised by a local teacher to run on the Sinclair Spectrum - predictably on learning grid references. It was in arcade form: a pin-ball bounced from intersection to intersection bleeping at every bounce, while a particular reference was displayed at the base of the screen. The pupil's task was to press the space bar (i.e. the firing button) when the ball bounced into the location indicated by the key. If the key was pressed at the wrong moment the screen exploded with a space-invader's noise, if correct the first three notes of Beethoven's Fifth Symphony broadcast. A score out of ten was accumulated. This program delighted a teacher audience more than any other.

Before we raise the alarm to defend the few remaining traces of high culture in our subject curriculum, and stamp out such vulgar practice, one might ask if it might not be the function of a microprocessor to rescue the lacklustre teacher from his daily diet of worksheets and dictated notes? Or do we believe that the human dimension is being diminished if pupils are fettered to keyboards and swamped with print-out information thus reducing us all to the depressive level of Marvin[7]? This raises a host of issues about the function of CAL in learning and socialisation, including its effects on both the pupil and the teacher. Ashley Kent has produced a useful summary analysis of computer uses, classified under student centred, teacher centred, and curriculum support-centred activities, and Shepherd's models of student/computer/teacher interaction are depicted and discussed[8]. For the past three years we have been monitoring local teacher attitudes in order to determine the feasibility of launching active development groups. It has become clear to me that until we have more settled conditions in both software and hardware, and able to note the effect of these small-scale programs along with those commercially produced, the demands on time and energy will be high and the returns low. I cannot as yet prepare a list of systematic criteria for the judgement of what constitutes an effective program for a worthwhile educational process.

For example, it may be that we can devise short programs based upon Ausubel's ideas of the "advanced organiser"[9]. But the most promising direction seems to me to be that which stems from the work of Piaget and Bruner, upon which the opening paragraph was itself based. The mastery of BASIC may be less urgent than is presently supposed. This makes the work of Papert quite central to our ideas of future development, and

why the branching programs which are content-free such as SEEK (ITMA-Longman) are of particular interest in requiring the child to reach forward from the threshold of his existing knowledge. And in terms of programme orientation and evaluation, Stenhouse's formulation of curricula as praxiologies - as hypotehtical strategies for realising ideas in practice (11) - appears highly relevant to our thinking. There is a long way to go, but the route is fascinating.

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3. The cost in Wiltshire for example was estimated £100,000 capital and £140,000 gross recurrent for 1982. Pratt, S. "Microcomputers in Secondary Schools". Education Management and Administration 11, London (1983) 57-61.

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SCOPE AND PROGRESS OF GEOGRAPHY CAL FROM THE CIC PROJECT

Deryn M. Watson

Background

As a nationally funded Project (Schools Council 1973-83; Microelectronics Education Programme (MEP) 1980-), Computers in the Curriculum has always been centred on an investigation into the potential of computer assisted learning to the secondary school. Based in the Centre of Science and Mathematics Education, Chelsea College, the philosophy has reflected an emphasis not on machines or software, but their role within an educational framework. The dominant concern to harness computing facilities on behalf of the learner has naturally influenced the style of CAL that it has fostered and the model for development. While working with a variety of disciplines (Physics, Chemistry, Biology, Economics, History, Geography, English, Foreign Languages, Maths., Craft/Design/Technology) one unifying theme has been that of interactive computing. This has led to a close relationship with the principles of discovery learning and the opportunity to enable and indeed encourage the pupil, via an interactive simulation, to ask the question "What would happen if....?(1)

Model for Development

Certain clear tenets which the CIC Project holds dear, have provided the focus upon which the CIC model for development has been based. Although these have been explained in greater detail elsewhere (2), it is worth itemizing here those that relate to the work described in this paper.

a) Teachers are involved throughout the design stage; creative and innovative

teachers are at the core of any curriculum development Project, and the importance with which they are viewed by CIC illustrates that the emphasis of our software development based as much on education as on micro-technology.

b) Although many teachers involved with the Project can program, the software is developed by professional programmers who act in partnership with the teachers throughout the development process.

c) All the material that is developed consists of both courseware (in the shape of teachers' guides and students' leaflets) as well as the software; thus we are concerned with a whole educational package.

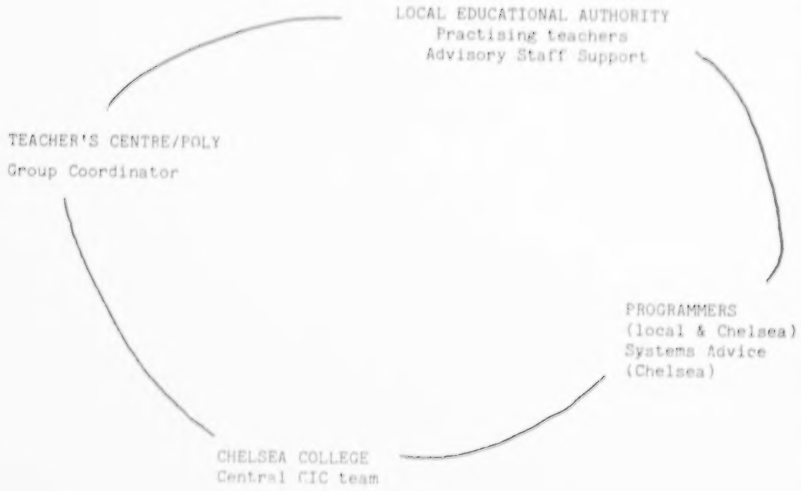
d) The Project deliberately avoids writing software that will replace the use of perfectly good teaching methods for the learning of a particular topic. CIC is concerned to look for those areas that have been difficult or even impossible to teach. The computer can open the doors to new areas, topics or techniques that have previously proved intractible to existing teaching methods.

e) Despite the above, the project's title indicates a clear concern for the computer to be used within the curriculum rather than covering an esoteric part of the fringe. The only way forward, as far as credibility of the existing materials which should lead to new and exciting possibilities, is to ensure that use of the micro is accepted within the normal current curriculum and its concerns. It is only on that solid foundation that we can look to the future and the wider horizons that this facility may offer.

f) All material is developed within the framework of a working group composed of a number of teachers of the one discipline, and the associated programmers and CAL designers of the CIC team. Although one particular idea may be 'seen through' by a partnership of one teacher and one programmer, they continually refer back to the whole working group. Thus the powerful and positive influence of peer group review is brought into play.

g) Following the group review, the material is then sent for trials by an independent group of teachers, who return detailed critical comments upon the use of the unit in the classroom. Such evaluation is essential.

This model for development can be looked at physically via the following diagram:-



a) CAL design skills
b) programming expertise
c) cross discipline fertilization

Such a development team, despite its dispersed nature, itself becomes a total learning unit. Each part contributes to the team, whether it is the keen innovative adviser in one LEA, the everchanging systems expertise based at Chelsea, the wealth of teaching experience embodied in the local teachers as well as the trials schools, or the growing body of people who are the new "professionals" in this area - the CAL developers/designers who act as a bridge between the world of education and that of the systems it seeks to use.

Such a model is costly in terms of time as well as financial and skills resource. It is not suggested that this is the only model that can be used (3) (4) but it is the one that the CIC Project has evolved over a period of time and is currently using.

Initial Results

The initial results of the work of the first phase of the Project (1973-81) was that it moved rapidly from using the computer as a number-crunching device into a concentration on simulations. With the emphasis on interaction the geographers added a particular dimension to the work by embedding many of the units within a gaming framework (5). In recent years this has been consolidated by a deliberate attempt to enhance the decision-making aspects of such simulations, and often to use a role-playing environment. Units such as ROUTE (6) and HILLS (7) highlight the way the humanities authors within CIC and the geographrs in particular, have taken the original discovery-learning aspect of simulations one stage further. Rather than encourage them to change the parameters and ask "What would happen if....?" the emphasis is now placed upon the decision of the individual who is involved in the learning. Thus the units are designed to encourage the user to ask the question "What shall I do?" (8).

The Project has never suggested that this approach is the only style of CAL that is relevant to the classroom. Some really exciting data handling packages (9) as well as much smaller units covering the simple concepts in geography (10) are being developed elsewhere; nevertheless CIC has felt it appropriate to concentrate on certain aspects and attempt to build up a core of skills in the design of such units.

Problems

Inevitably there have been a variety of seemingly enormous problems that have faced us, and other CAL developers in the UK. The most obvious immediate one ws the relative scarcity of hardware in secondary schools, and the lack of standardization and coordination between those that were already relatively well-equipped. Thanks to the Department of Industry initiative (11) we now know that since 1982 90% of all secondary schools have at least one micro, and it is usually a BBC Model B or RML 380Z. At the same time the Department of Education and Science's initiative, the Microelectronics Education Programme (M.E.P.) (12) has initiated a comprehensive attempt at raising the general computer awareness in the teaching profession through the inservice scheme. Nevertheless it is clear that the average geography teacher today is still faced with somefairly major problems.

a) the currently available geography software is of a "random-pecking" nature. Odd topics scattered across the geography syllabus may be covered, but not in a coherent way (13). This can be a major deterrent in the days when teachers can acquire resource a pack to cover whole aspects of any one syllabus.

b) Geography is a rapidly changing subject. There have been many swings of the pendulum in the last 20 years. Because of this it is only too easy to write software today that, by the time it is available, suits yesterday's classrooms.

c) Despite the efforts of the M.E.P., there is barely the critical mass of geography software available that will ensure that the teachers can choose what is required in their particular environment. If there are only three occasions a year in which they are tempted to use the micro, then it is, for the teacher, quite rightly, barely worth the effort of mastering and feeling confident with the hardware to use such a small amount of software.

d) Despite the sudden increase in hardware availability, most teachers will at best be working with one micro per class, and that micro often has to be brought into the geography room for each occasion it is required. Although challenging, and certainly not insurmountable, it is a constraint that will affect how the software is used and may limit its learning potential. We are still a long way from the multiplicity of hardware facilitating a release from the "30 pupils in 1 class" environment that we find in the average secondary (11-18 years) school.

Progress

Nevertheless progress has been made, and quite rapidly in the early 1980's, along certain particular lines.

Relationship with the innovative curriculum

In an attempt to remedy some of the problems already referred to in particular that of "random-pecking" and software for yesterdays classrooms, an initiative was taken to set up a working group that was related to one of the innovative geography curriculum Projects. Through personal contacts, the Geography 16-19 Project was identified and teachers who were associated with this Project and familiar with its philosophy and proposed curriculum, formed the basis of a new CAL writing group of the CIC team. This has been a most stimulating and also fruitful cooperation. 4 units are now published that relate to specific themes of the 16-19 Project, but which also relate tomuch of what is currently of interest to 6th form geographers - e.g. Urban Growth analysis (14) and a mineral exploration exercise (15).

This close relationship with a curriculum development project has now been mirrored in 2 other subjects in the CIC (economics and history) and it would seem appropriate for other existing (e.g. GYSL) as well as new Projects just beginning, to have an educational computing awareness and even positive component in their working groups.

Relationship with the rest of the Geography CAL community

There are not all that many geographers engaged in this field of work, but the Geographical Association via its Educational Computing Working Party (currently under the chairmanship of David Walker, Loughborough) has provided a most useful form for debate. It is imperative that people in various parts of the country share their experiences, and in this field in particular it is extremely easy for many isolated groups to be perpetually reinventing the wheel. Although this committee has neither the brief not the funds to draw all the work together in some attempt at coordination, it is intending to play a greater role in the informat and evaluation aspects of CAL. This is a natural and valuable role for a subject association to take. The problem of coordination is one that the MEP, as the principal commissioning agent at the moment in the UK, has so far been unable to tackle. it is to be hoped that in the future there will be a method of redressing this.

Relationship with other disciplines

The CIC Project is relatively unusual because of its size. Although this may have drawbacks in managerial terms, there are certain gains in both economy and the sharing of skills. One particular asset is that the geography work of CIC takes place within the framework of a humanities section. Thus I am in regular contact with working parties in economics and history, as well as English and Foreign Languages. The opportunity for some lateral perspectives and cross-discplinary fertilization has been most valuable, and some units. e.g. MILL (16) reflect this aspect, where there are significant historical and economic components. The other strand of environment science should not be ignored. Thus ROUTE (17) is a unit developed by physicists and geographers. And the problems of model building that can face the geographers and economists can be shared with the scientists in the team so that a most appropriate solution

is found.

Current Issues

There is no doubt that the trials procedure of the Project, in terms of the peer group review and the trials schools, increases the length of time which it takesto develop a single unit. Indeed, the Projectmay have to wait up to six/nine months before the school is tackling the particular area of the syllabus that the unit relates to. The Project then expects to take the resultant feedback seriously, and occasionally a unit can be almost entirely re-written before it is ready for publication. All this adds to the total time period of development which any one unit takes; indeed it is rare for this period tobe less than 18 months,and is more frequently 2 - 2½ years.

The Project would like to see more independent evaluation take place by professional educational evaluators. This is important in a field which is so new and in which the development team may take certain aspects of CAL for granted. Accordingly as a pilot scheme the units developed by the joint Economics Association 14-16 CIC Working Party have been the subject of an independent review, the report of which is due in the summer. It is to be hoped that further work of this nature can be undertaken, but there are severe funding implications.

The teachers are still facing major organizational problems in schools in terms of how they utilize the new resource and potential. They are often at a relatively "initial" stage of computer awareness, and have not the access to a large bank of educational software with which they can browse and learn. We still have not got that critical mass of software. All these issues are bound to affect the sort of feedback the Project receives. On the one hand it can be naive; indeed virtually any software produced in the UK today is

likely to be published or made available via an exchange scheme. This can create a false impression of what is good software or of value educationally. It may even do CAL a disservice because it will "put off" a variety of teachers from investigating further. On the other hand some software may not be used to its full potential because of a general lack of awareness of what such a potential is or can be. These matters are bound to colour the way teachers think about geography software today.

One strength of the CIC Project is that it is not just a software production factory, but an educational research and development team that is concerned to address these and other issues as they relate to micros in the classroom. Such concerns however inevitably add to the time and therefore resource implications for any one unit that is thus produced. Comparison with other groups whose concerns are not so broad can therefore be misleading.

Two illustrations

Two particular units that have been recently completed and published will be described briefly here in an attempt to illustrate these points.

Sailing Ships Game (WINDS [18])

This unit is designed principally for use with the 12 plus age group, although it could be used with a variety of ages and abilities. The pupil(s) is asked to adopt the role of a sailing ship captain (no engine is available) and is offered a choice of ports across the world between which they navigate. After choosing the time of year to begin the voyage, they are then left to respond to the wind conditions (direction and speed) as they appear on the ships log. The path they choose to navigate is plotted on the screen.

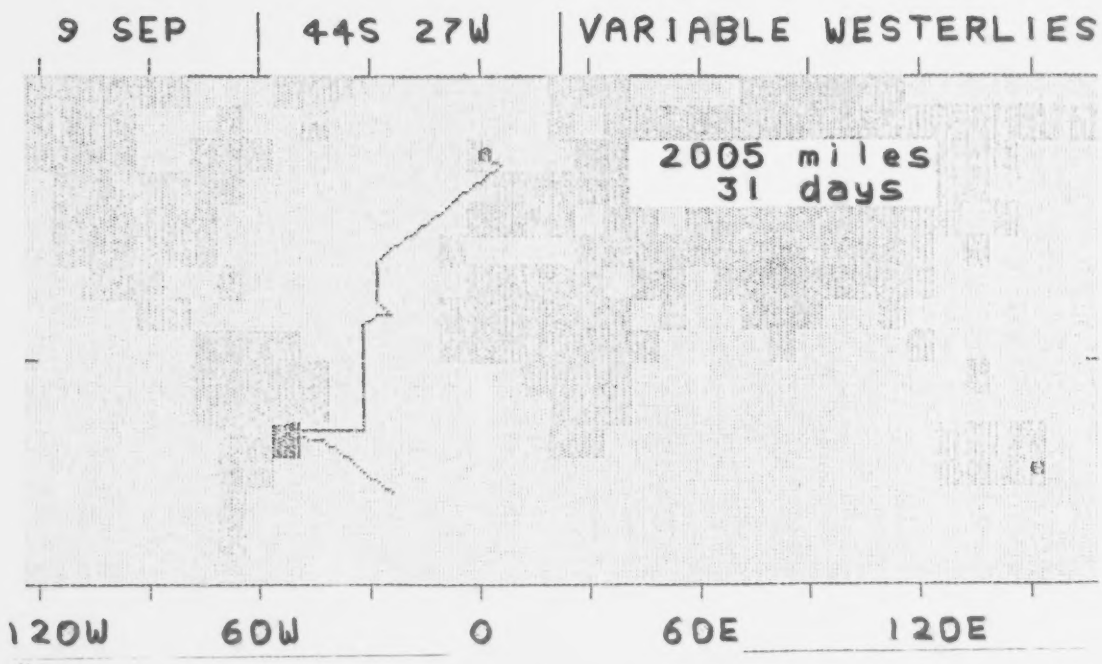


Figure 1 Screen image from WINDS - the captain has sailed from London to Rio. A second voyage Rio to Sydney, is now underway with the ship heading into the South Atlantic.

This role playing simulation was designed principally to attempt to teach the wind zones of the world and their seasonal movement. Understanding of this feature, and subsequent successful application of the knowledge to an appreciation of climatic zones is a notorious problem area in geography. This unit is thus a real attempt to use active role playing as an alternative methodology. It can also be used in relation to the voyages of discovery or the early trade routes (e.g. the Tea Clipper Races).

Figure 1 is an illustration from the program. Although the world outline may appear crude, by being designed in that form this program runs on 4 different micros (RML, 380Z and 480Z, BBC Model B, APPLE II and Commodore PET). Trials indicated that the pupils had no problems with it, and geographers themselves frequently use simplified map forms. High resolution graphics, although most powerful, are not always essential to the learning process.

Water on the land (PUDDLE [19])

A totally different style of unit is found in Water on the Land. Designed principally for use with sixth-formers (16+ age level) it offers the opportunity for the pupil to examine the model of a flow of water through a theoretical, level block of land (from surface to base level) under a variety of circumstances. The pupils themselves may vary the seasons, weather conditions and duration of the rain and watch the dynamic movement of water, as well as extract the exact quantities involved in each movement (e.g. drips or base flow). Figure 2 illustrates one particular frame from the program.

Model examination while at the heart of some conceptual understanding can be hand when we may not know the exact parameters which will makeup the model - we only know the relationships we expect to observe. The availability of

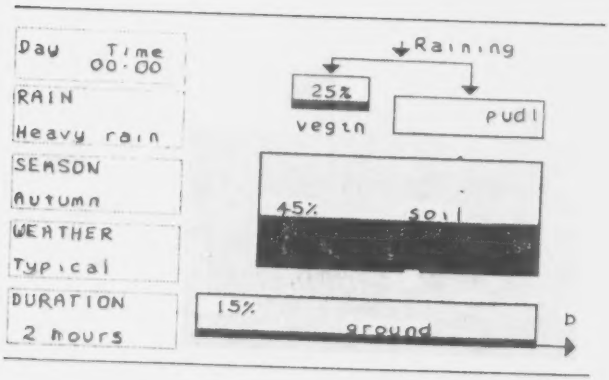


Figure 2 Screen image for PUDDLE. The conditions to be simulated have been set in the boxes on the left. The run is about to begin.

computing power and the [illegible] that it demands is imposing [illegible] strictures of thought upon us when we may previously have been content with more vague discussions of relationships. The economists are facing similar problems as they attempt to produce simple but accurate models for interactive examination in the classroom. This is an area where the potential [illegible] demands of the micro are proving most stimulating to a variety of disciplines.

The Future

The work completed so far has only served to wet the appetite of the Project to investigate still further the potential of the micro to education. There are some specific aspects which seem most attractive and issues that demand further thought. Amongst these are the value of designing to accommodate role-playing and decision making, encouraging discursive work around the keyboard and capitalising on its motivational potential, looking closely at the inter-disciplinary issues, and keeping in touch with the work of the artificial intelligence community.

These future directions of CAL, and the particular interests of the Project must surely interrelate with the future directions of the curriculum as a whole. Introduction of networks, large scale information - retrieval capabilities and other peripherals may have a significant impact on the physical way the average secondary school is organised in order to foster teaching and learning. This will inevitably affect the type and style and variety of educational software that will need to be developed.

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COMPUTER ASSISTED LEARNING IN THE GEOGRAPHY CLASSROOM - EXPLORATIONS WITH VIDEOTAPE.

Patrick Wiegand

Introduction

Despite a growing literature on computer assisted learning in geography and an increasing interest and awareness amongst geographers of the potential of the micro for teaching, there has been little observation and evaluation of the ways in which computers have been used in the geography classroom. Four models of the types of relationship that may develop between the computer, the teacher and the student were proposed by Shepherd as early as 1978. However, this was at a time when there were as yet few microcomputers in schools and the models appear not to be supported by empirical data. Hartley and Bostrom's (1982) evaluation of micro CAL in schools used observations of 22 lessons, only two of which were geography lessons. The initial aim of the investigation reported below was modest : to document and reflect upon the use being made of micros by geography teachers in this early stage of computer use and program development in geography. The word 'explorations' was used in the subtitle as this paper represents a 'first report' on a limited number of classroom observations.

One of the problems of classroom studies is the range of theoretical and methodological approaches available (Hammersley, 1982). Classroom research in computer assisted learning has largely been within the positivist tradition. Classroom interaction analysis, for example, (the SCAN notation) has been used in the context of mathematics by Beeby et. al. (1979) and teacher styles have been compared in geography computing lessons by Hassell (1982).

/At

At a time when computing in geography was not widespread the present writer was content to report on ways in which micros were used in geography teaching as a pilot for further study and in order to adumbrate the most successful teaching strategies. Of particular interest was the use made of language in geography lessons where a computer was present. This, it was thought, might provide documentary evidence for teacher attitudes towards the use of the micro in geography teaching and illustrate styles of pupil and micro management. The lessons were recorded using videotape. This medium was chosen in preference to audiotape because it was possible to record the VDU or monitor display as well as the pupil and teacher talk and secondly because of the potential of videotape in pre and inservice teacher training. Extracts from contrasting lessons have been used successfully in PGCE courses and in regional and national inservice courses in computer assisted learning. On such courses videotape can complement practical computing workshops by illustrating how teachers set up hardware, organise pupils and cope with classroom problems.

Data Collection

Videotapes were made of twelve lessons where a computer was used to teach geography. This was thought to be a suitable number of lessons on which to base preliminary observations. (Barnes (1969) had used 12 lessons in his study of language interaction in the secondary classroom). All the lessons were observed in high schools in the West and North Yorkshire MEP region. Computer-using geographers were identified by a questionnaire, sent out as part of a collaborative investigation to monitor the development of computing in geography in the Bristol, London and Yorkshire areas (Hall, Kent and Wiegand 1982). At the time

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the lesson observations were made 31% of the geography departments in the region responding to the questionnaire (65%) had taught at least one geography lesson using a microcomputer. The questionnaire asked Heads of Geography when next a computer was likely to be used for teaching geography in their department. Schools were contacted by telephone when a lesson was imminent with a request to observe and make a videotape of the lesson. Each lesson observed was as part of the normal teaching sequence, i.e. there were no special demonstration lessons. Teachers were interviewed a few days prior to the lesson and the basic pattern of the lesson - aims, teaching sequence, anticipated outcomes, etc. were discussed.

Videotaping the lesson was made easier by the use of lightweight, portable VCR equipment. All the videotaping was done by the writer. This was thought to be important as, although the quality of the tape was less professional than a TV crew could have produced, the number of strangers in the classroom was reduced. This caused less of a threat to teacher confidence and reduced distraction to pupils. Sometimes two cameras were used : one on a wide-angle lens setting at the back of the class and, where appropriate, one recording the activities of a group of pupils seated at a microcomputer.

The potential of videotape for classroom analysis has long been recognised (Adams and Biddle, 1970) but the technique of recording presents a number of practical problems (Bailey, 1979; Middleton, 1981.) Shortage of power sockets in older classrooms is common, especially where several micros are used in addition to the recording equipment. Trailing extension leads and camera cables can present a safety hazard. In terms of the selection of camera positions, however, there can be a

/conflict

conflict between what represents a good record of the lesson for research and what constitutes good television for an inservice course audience. The former may require a static camera with a wide angle field of vision whereas the latter may require varied camera positions with more close-focus shots.

Although picture quality is generally good, even in low light conditions, sound quality is a major problem. Teacher talk can be recorded easily from a microphone built into the camera but pupil talk (often more hesitant, mumbling and with a more pronounced regional accent) is often directed away from the microphone and is difficult to record. A portable, directional, microphone often requires an additional operator. A tie microphone used on the teacher can constrain movement around the class.

At the end of the lesson teachers were asked if the presence of recording equipment made any significant difference to the behaviour or response of the class. In all cases the answer was no. After a brief initial period both teachers and pupils appeared to ignore both the observer and the cameras. The tape itself was shown to the teacher as part of a post-lesson interview. During this, each teacher was asked whether the lesson had gone according to plan, whether the aims of the lesson had been achieved and what learning had taken place. Permission was sought to use the tape for pre- and inservice teaching if appropriate.

The Lesson Observed

A breakdown of the number of lessons by age of pupils, size of class and name of program is shown in Table 1. Note that in Leeds and Bradford entry to high school is usually at the age of 13. Lessons with 11-13 year olds may therefore be under represented. All the teachers observed had approximately ten years' teaching experience and most were Heads of Department. All had taught at least six previous lessons using microcomputers. They represented a selection of the most computer-experienced geography teachers in the region.

The programs used in the lessons observed were representative of the geography programs used throughout the region (Hall, Kent and Wiegand, 1982). These were mainly from the Schools Council Computers in the Geography Curriculum material (Watson, 1979). DEMOG was the most popular program amongst geographers in the region. It allows the user to make population projections using data provided or new data. Birth and death rates can be altered and the program will display population pyramids as well as numbers. Pupils learn the long term effects of changes in birth and death rates. MILL is a game where windmills are located on an imaginary island. The program calculates the cost of locating at each possible site in terms of transport costs, power supply etc. Pupils learn which factors affect the location of mills.

FARM is a simulation where fields on one of three farms are planted with a choice of crops. The return on each field is then determined by weather conditions typical of the region in which the farm is located. Pupils learn the most appropriate combination of crops for each region and the effect of chance weather conditions on income. GRAVITY (Stevens and Blandford n.d.) is a program based on Huff's probability model of consumer behaviour and calculates the

TABLE 1

Summary of lessons observed

Program used	Age of Pupils	No. of pupils	No. of micros available	Type of lesson organisation
DEMOG	13-14	16	8*	groups (static)
DEMOG	13-14	25	2	groups (cafeteria)
DEMOG	13-14	26	1	whole class (plus contestants)
DEMOG	16-17	10	1	whole class (plus contestants)
MILL	14-15	32	2	groups (cafeteria)
MILL	13-14	24	4	groups (static)
MILL	13-14	24	1	groups (cafeteria)
FARM	13-14	16	3	groups (cafeteria)
FARM	13-14	25	3	groups (cafeteria)
GRAVITY	16-17	12	1	whole class (plus contestants)
HURKLE	11-12	27	1	whole class (plus contestants)
NETWORK	17-18	12	2	groups (cafeteria)

* mini computer with 8 terminals

probability of consumers at a number of locations visiting a choice of market centres. The user must input distances from consumer locations to market centres, the size of market centres and a value for the exponent in the gravity formula. NETWORK is a program developed by the teacher who was being observed which calculates connectivity and accessibility indices for a given transport network. HURKLE (Shepherd, n.d.) is a grid-reference practice game. An imaginary animal is hiding in a square-shaped region. Its location must be found by guessing coordinates. Clues (e.g. "Go northwest") are given to the player who must find the "hurkle" in a prespecified number of guesses.

Lesson Analysis

Two aspects of the lesson transcripts are selected for study here. Firstly, teacher attitudes towards the micro and its use in geography teaching. Secondly, the style of class and micro management adopted by teachers. Transcript extracts are used below for illustration. It is primarily teacher talk that has been selected here.

In all the lessons observed the teachers made explicit justification for the use of the microcomputer in geography teaching. They commented to the class (or jointly to the observer) on its advantage as a rapid calculator, enabling pupils to see the results of calculations they either couldn't do or that would take them too long to do by hand.

Teacher Right, now it says "Calculation in progress". A series of noughts appear, that's quite O.K. The calculation is in progress. The computer is working it out. The computers are very fast. The amount of time that computer is taking to work out your little exercise tells you its a very complex one. It would take you several weeks to work it out by hand. So we have a short pause while we wait.

(3rd year, MILL)

In one lesson (GRAVITY) pupils had difficulty with the simple arithmetic necessary to tot up distances to enter into the program. The gravity model calculations by hand would clearly have posed problems. Although reference was made to the potential of the computer in individual projects its sole reported advantage as a learning aid was as a fast calculator.

However, despite the speed of calculation the use of the micro was seen as potentially hazardous. Strict teacher control was deemed necessary and teacher instruction had to be closely followed.

Teacher Now, bring your chairs so that you can sit round. The first thing is that a lot of these computers, they reckon they're child proof and idiot proof but this isn't so. It's very easy with a lot of these programs to whats called 'crash' a program, that is be pressing the wrong thing at the wrong time and completely wipe out what we're trying to do, so for the moment don't touch anything unless I've told you its O.K. to touch it. O.K.?

(3rd year, MILL)

Successful operation of the micro was seen as requiring acquired skill. The pupils would initially need teacher help. The whole structure of the lesson was generally devised to enable the teacher to provide that help. However, once the teacher has provided the necessary guidance, pupils would be able to proceed on their own.

> Teacher Most of the questions it wants you to answer will be very clear. It will say "type YES" and "type NO" or whatever it wants you to do. The first time you use the computer, the first time each group comes out, I will stand with you, and I'll just have a quick check so that you know what you are doing. If you get an answer that doesn't make sense, - it tells you something like - "type mismatch" or "syntax error" and it just won't do anything - just tell me, and I'll come and I'll sort it out for you - O.K.? Most of the time you should find that you can run it without me having to be standing over you. The second time round, I won't stand over you. It's exactly the same sort of process and you should be able to do it without any help. Is that clear?
>
> (3rd year, MILL)

Many of the teacher comments about the micro betray teacher anxiety or anticipate anxiety on the part of the pupil.

> Teacher For those of you that haven't used the machine before I'll hover so you feel safe.
>
> (5th year, NETWORK)

All the lessons observed were strongly teacher-directed. This was clear not only in whole class teaching but also in group work. In the following lesson extract the teacher has directed each group of

pupils to alter birth or death rates in a carefully prescribed way. He will then demonstrate the results of such changes later using the figures and pyramids each group has produced.

> Teacher Our chief aim is to set up a number of scenarios for population development in third world countries, and in England and Wales. Group 1 for example are looking at what happens when birth rates fall slightly .... group 1, I'd like you to go on raising your death rate after 2020, so if you can remember to do that ....
>
> (3rd year, DEMOG)

Later in the same lesson the teacher refers to a handout in which the basic structure of the pupils' tasks are set out.

> Teacher (referring to handout) I've listed at the bottom of the first page the years for which you'll carry out the projection.
>
> (3rd year, DEMOG)

Significantly, every lesson observed made use of a worksheet. The central task in most lessons was to complete this handout. Pupils worked through pre prepared stages, completed boxes, entered scores and drew graphs that had been pre-scaled for them. The results of the pupils' computing were then collated by the teacher and used in whole class demonstration and exposition. This style of teaching has its parallels in the hypothesis-testing, data-collection style of fieldwork in which each pupil or group collects, for example, CBD land use data and then pools results for a class map. In this respect the pupils'

role is as data collectors and data manipulators.

In all the lessons observed the teachers kept a tight rein on the learning that was taking place. In the following lesson the teacher is not only leading the pupils' thinking, but at the end puts a brake on their curiosity to discover what will happen if the population were to continue growing at the same rate. The pupils in this group have been examining the population growth of a less developed country. They have followed the instruction given by the teacher and he is now telling them what they should have noticed.

Pupil (referring to printout) That's impossible!

Teacher 200 and what

Pupil 293 million

Teacher No, it's not impossible, it's quite likely isn't it?

Pupil Oh!

Teacher Can you explain why it's 293 million?

Pupil It's sort of exponential growth....it sort of doubles... or whatever.... and keeps going on like that, just adding on.....

Teacher And why is it growing so sharply?

Pupil Well its still got a very high birth rate but, er, a very low death rate because now....

Teacher .....relatively low, yes

Pupil ....they've got medical care

Teacher And what about the pyramid shape? Any changes? What about the sides of the thing?

Pupil Well it's just sort of....

Teacher They're concave aren't they?

Pupil Yes

Teacher Yes, so you've probably seen very little change actually have you?

Pupil — No, not as far as actual shape is concerned. It's just that the numbers get bigger.

Teacher — Right, so exponential growth then, and a wide difference between birth and death rates tends to produce that sort of pyramid and that remains stable doesn't it, over the years?

Well, you're almost ready to start graphing aren't you? The figures that you'll graph are those at the top here, you see, in each case. The graph paper has been scaled for you, ready for that. O.K.?

(later, another group are projecting their population figures forward)

Teacher — How far have you got?

Pupil 1 — (Year) 2020

Teacher — Yes, do 2040 and 2080.
Finish when you've done 2080.

Pupil 2 — We might be able to do 2090.
No, finish when you've done 2080 and then construct your graph.

(3rd year, DEMOG 2)

Although this last section of the transcript could be interpreted as the teacher leading pupils away from unnecessary repetition of a task, it seemed at the time that the discovery of a pattern of demographic change was being stifled.

It is possible to speculate as to why the lessons observed were so strongly teacher-directed. Firstly, no examination was made of non-computing lessons taught by the teachers observed. It is possible that the twelve lessons described here represent styles normally used by the teachers concerned rather than styles deliberately adopted in response

to computing lessons. Secondly, shortage of time may have disposed teachers towards a strongly teacher controlled framework to the lessons. Many teachers were conscious of the time factor in their lessons. About half the lessons were observed in a special computer room. The other half were observed in the geography room or normal classroom and the microcomputer was brought in by trolley. In either case the room and or computers had to be booked in advance and were not necessarily available for the next lesson. In all the lessons observed the computer was used for one lesson only, usually preceded by an introductory lesson and followed by lesson in which the results were discussed. Time therefore was a major preoccupation.

> Teacher Right, while you are waiting your turn - Richard - each group has got some tasks to get on with. If you haven't selected the sites - well - which you ought to have done - then you have a priority. You must get your site selections made, because if you haven't got your site selected when it is your turn to use the computer, you lose your turn, and we will fit you in again at the end, if we can, but we may not be able to. We're on a tight time schedule.
>
> (3rd year, MILL)

The limited access to the hardware available seemed more critical than any shortage in the number of micros. Teachers were as anxious to complete the computing tasks in the one lesson whether there was one or eight micros present.

A third possible reason for the strong element of teacher direction may be the desire to achieve a satisfactory result, especially in the presence of an observer. This feeling may be heightened by

relative inexperience in the use of micros in the classroom. It may be that a safe, conservative or traditional style of teaching is a necessary stage that we pass through when faced with an innovation.

No attempt has been made here to identify classroom styles in CAL based on the number of lessons observed. However it is possible to identify a number of strategies adopted by teachers in managing the microcomputer in geography teaching. It is also possible to highlight ways in which pupils participate in those lessons.

The problem for most teachers was how (within one lesson) to maximise the amount of pupil-computer interaction. "Hands on experience" had become a watchword for all the teachers and they were concerned to allow pupils as much of this as possible. This concern, and the number of micros available appeared to determine the way in which the programs were utilised. Group work was adopted in half the lessons observed and whole class teaching in the other half. Groups were managed in two main ways: firstly, stationary groups where pupils stayed as a group at the keyboard and monitor for most of the lesson and secondly, groups using a smaller number of micros on a cafeteria basis. In the latter type of lesson pupils are given a number of tasks, one of which involves the use of the computer. They work at the other tasks until a computer is free and then proceed to their computer task. Teachers preferred to use the former arrangement when sufficient micros were available. Groups of three were typical. In one lesson where groups were stationary and there were six pupils per micro there was very little participation by the "second row" of pupils at the machine.

Participation by pupils in groups was most commonly as

committee members. Each member of the group had a defined role. Groups were often in competition with each other (for example to produce the lowest cost site for windmills). Sometimes this competition was deliberately planned by the teacher - for example in one lesson each group acted as a committee of planning consultants who had to produce a well prepared report on the siting of mills. Each group was competing for the 'contract' to build the mills. In the following extract the roles of the committee members appear ambiguous as the teacher leads them through a "dummy run" of the program.

Teacher Now lets just try one all together. Now this isn't going to be the one you're going to use. I'm going to make up one or rather use one from the map. Your computers should all say at the moment: "Which version of the game 1, 2 or 3?" Do they all say that?

Now can the person, remember yesterday when we got into groups one person was elected chairperson, one person was elected secretary and one person to initially start typing things in. Now can the person who your group chose to be the first to have a go, can you type in the number 1. Find one on the number area, type it in. Have you all done that? Right now whenever you put something in like that you then press Return. Press Return next.

Right now it should say Mill No. 1, has everyone got that? (Assent)

(3rd year, MILL)

Whole-class teaching was usually adopted by teachers with only one micro. In addition to "normal" participation by pupils in these lessons all the teachers observed who were teaching to the whole class invited one pupil or a succession of pupils to type at the keyboard. This is a version of the popular teaching technique of asking a pupil to come to the front of the class and demonstrate a point on the blackboard. As operating the computer was seen as being a special treat and as the pupils' involvement was similar to that of the T.V. quiz or game show in which members of the audience are selected for participation, the term contestant seems appropriate. Pupils take it in turns to (e.g.) find the "hurkle" within the prescribed number of guesses or locate the mill more cheaply than the previous contestant. Audience participation in the form of calling out advice etc. is often at a high level. Teachers justified the use of contestants in lessons on grounds of increased motivation and as an opportunity (albeit limited) to provide 'hands on' experience for at least a few pupils. In the example that follows the pupil at the front does not participate on his own behalf as a contestant making his own decisions but acts as a more passive button presser entering responses decided on by the teacher and the rest of the class. Apart from a cynical view of ministerial responsibility note how the teacher refers to the computer's role in the lesson and how he acts as an intermediary encouraging the class to give instructions to the button presser.

Teacher Yes, its very difficult to do a census and get all the results immediately. It often takes several years before the results come out, and censuses are often taken how often?

Pupil Every 10 years.

Teacher Every 10 years. So, its likely that if you had to do this job today the most accurate figure you would have is, say 1971, which you're provided with. What you would then need is some nice calculator to help you work out how many people there might be, and, some intelligent guesswork. Well, we've got the calculator here, thats why we're in this room, with the computer, and we've got a program which quite conveniently does all the calculations for us. So we're just using this as a calculator today. Now, who's going to be the Minister of the Day?

Pupil (inaudible)

Teacher Well, you've just volunteered yourself Martin, come on.
(pupil goes to front).
There are 3 TV screens, so people at the back can look at that one by the window.

(The program has been set up in advance and the only word on the screen says "Country?")

Right, what's the country?

Pupil India

Teacher Right would you like to type in India? "I"

(Pupil enters India)

There's a button marked "return", would you like to press that?

Top right. Yes. O.K.

What's the year of the information?

Pupil 1971.

Teacher 1971. Numbers are on the top (of the keyboard)

(Pupil types 1971)

Press return. Good.

Someone tell him, from the sheet, what the population was?

(later):

Teacher Right. We want to know the percentage increase don't we? Now look at those figures. Where does it say increase or decrease? Someone help him.

(to boy at front) You just be a button presser for the time being. You just do as you're told. If you're a Minister you get all these civil servants to do the work for you don't you?

(to class) Right, come on then civil servants. Where are we told this information? Right, go on.

(3rd year, DEMOG)

CONCLUSION

All the teachers observed maintained strict control of the learning that was taking place in their lessons. Little independent exploration of the programs was permitted by pupils. Little opportunity was given for the pupils to ask "What would happen if...." questions of the programs and yet the application of such questions has been regarded as a strength of computer assisted learning. No evidence was seen of "serendipity learning" (Rushby, 1979). All the teachers wanted their pupils to have maximum access to the hardware and yet, paradoxically,

they exhibited a strong desire to control what pupils learnt from that access. In Shepherd's (1980) "gatekeeper" model the gatekeeping nature of the teacher was in respect of access to hardware:

> "In the 'gatekeeper' model, the teacher sees the computer as his personal preserve, and any access by students is carefully controlled and monitored. Sometimes a teacher is unwilling to allow students any direct access to the computer. This clearly denies students any opportunity of learning by their own experiments".
>
> (Shepherd et. al., 1980, p.116).

What is proposed here however is that teachers were acting as gatekeepers to pupils' personal interaction with the programs. In every case teachers were initiators. There was little partnership in learning.

Interviews before and after the lessons also confirmed Hartley and Bostrom's (1982) findings that 'teachers did not break new ground, but used the programs to consolidate principles they have covered immediately before'.

It is clear that computer assisted learning in geography is still at an early stage in its development. Classroom implementation of CAL is closely related to the nature of the programs. At the time of writing (early 1983) the number of programs available commercially to geography teachers has just doubled. New styles of program (for example using micro QUERY and allowing data base interrogation) imply new styles of classroom use. It remains to be seen to what extent the balance of control and initiative will now move from teacher to pupil and program.

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TEACHER AND PUPIL INVOLVEMENT IN CREATING COMPUTER PROGRAMS IN GEOGRAPHY

Iain Ferguson and Gerry Hones

Whenever something new appears in the world of curriculum development - whether it is a basic philosophical change, a new technique or a piece of equipment, there is inevitable range of reaction from classroom teachers. The literature concerned with curricular innovation shows how the diffusion of new ideas is affected by the same factors time and time again. Some are essentially practical, such as insufficient money being available for support in such areas as providing in-service opportunities (Barr and Williams, 1984) or purchasing resources. Other influences may be basically attitudinal, with teachers reacting to the innovation according to how they perceive new ideas in general as well as any one idea in particular. The advent of micro-computers in the geography classroom appears to be meeting the classic responses.

Fig. 1 Reaction to Innovation

BAND WAGON RIDERS

?

REAL INNOVATORS

HEAD IN SAND

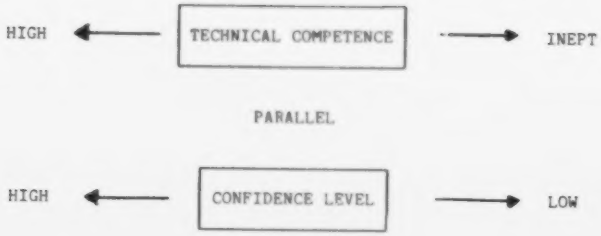
?

SENSIBLE DOUBT

One could categorise teachers (Fig. 1) by locating them on a scale according to the degree of enthusiasm they show for this new approach but this can be very misleading. For example, those teachers seen as being at the 'positive' end of the spectrum because of their demonstrated enthusiastic reception of the innovation may be there for the best of reasons, having carefully appraised it and realistically judged how their teaching could be improved by its use. On the other hand, others will appear as enthusiasts without having carefully evaluated how the new idea could fit into their own situations. The speed of the 'take-up' may soon be balanced out by the speed with which the idea is dropped. One can draw a simple parallel with the parable of the sower and the seed!

Similarly, at the 'resistant' end of the scale, although some teachers will be there because of their dogged determination to avoid any involvement in technological advances (a group of classroom Luddites?), others will be viewing the arrival of micro-computers with very justifiable doubts about their value both in general terms and to them as particular individuals. General terms could include the genuine belief that such technical equipment can hinder the learningprocess by creating an unnecessary barrier between teacher and pupil (Kent, 1982) rather than acting as a catalyst or an aid to the growth of relationships. However, it is probably a more personal, subjective reason that is dominant. For example, many teachers will believe that the micro-computer does not fit easily into their own teaching style and are not prepared to change this style for what they may see as only 'possible' advantages (Hassell, 1982).

Fig. 2 Teacher Competence



Another related reason will be the level of general technical competence that the teacher possesses - or, perhaps more important, the level that the teacher thinks he or she possesses (Fig. 2). Those teachers who face a piece of equipment like a slide projector or tape recorder with a basic confidence in their ability to operate it, even when it is an unfamiliar model, are those who are more likely to respond positively to the challenge of another piece of technology. They begin with a basic confidence in their own ability to master its complexity and so add it to their range of supportive resources.

It could thus be argued that it is the degree of confidence held by the teacher which is the key to progress in the use of micro computers in the classroom. All potential users, irrespective of their starting point, need to be involved in practical experience. The unskilled need patient assistance to show how many fears are unfounded if a step-by-step approach is applied - the over confident, or the uncritical accepters of the idea, need to face up to the realities of technical hitches when hiccups in the programme can ruin a carefully planned lesson. In all cases, the central need is for software which is of the right type and while there is a growing range of commercial

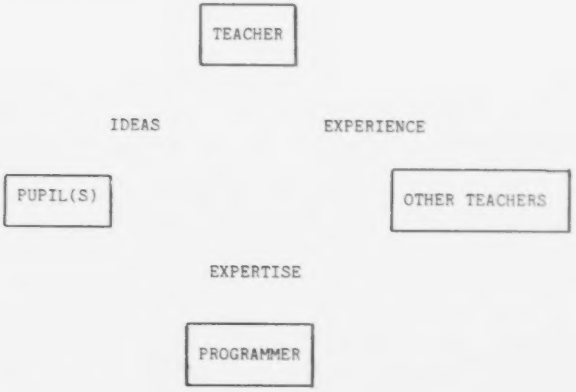
packages being available, it may well be that future use will also rely upon 'home produced' programs in certain situations. Such programs could well have the major advantages of being 'relevant', as seen by the teacher, and specifically created to meet a particular local need.

Nevertheless, whatever programs are used, many believe that a major hindrance to progress is the need for teachers to accept what for many would be a major change of role in the classroom i.e. from 'controller' to a less dominant role as 'cooperative manager'. It is significant that much of the computer-assisted learning observed in geography classrooms thus far has shown the lessons (i.e. the manner and speed of progress including the actual machine operation) to be heavily under teacher control (Wiegand, 1983). The lessons could generally be described as neat packages, carefully planned, resourced and operated extremely efficiently, but always along lines strongly defined by the teacher. Too few examples have been found of lessons where the pupils had the opportunity to 'enquire' more openly, to search out answers and ideas in ways which were not strongly prescribed. Sometimes this stems from the degree of teacher control - on other occasions the limitations derived from the rigidity of the programm, the way in which it necessitated a linear approach and offered few opportunities for useful and interesting exploration into unspecified areas.

A possible answer to this problem could mean asking the teacher to move even further form the control position and become a 'cooperative developer' by working <u>with</u> pupils to create programs designed to meet their own specific needs. A number of teachers have already appreciated that their pupils, covering a wide range of ages and even 'abilities' (as measured in conventional terms) can often offer an expertise in programme development.

Such teachers have seen their pupils as partners in a cooperative venture and the combined result has been a programme of considerable value in itself as well as the wider benefits arising out of such cooperation. The actual programme may be a part of a pupil's 'individual study' or created to fill a gap as seen by the teacher. For example, one departmental head worked with a group of his pupils to develop a programme which enabled the user (either teacher or pupil) to feed in any selected data for each month's mean temperature and precipitation and then obtain a visual display of the data in the form of line graph and histogram. In that particular case, a reasonably workable programme was turned into a final version by a sympathetic professional programmer known to the school. The result is a relatively simple but very effective way of portraying some basic seasonal climatic data for any station, with the considerable advantage of very rapid alterations being possible whenever it is wished to examine a different pattern.

Fig. 3 Program Development



The simple diagram (Fig. 3) attempts to show the cooperative relationships that can exist, not in any rigid pattern because the actual balance of input will change according to each special case. For example, whereas the teachers will be more likely to contribute the geographical ideas, the theoretical structure and concepts involved, they could also originate from the pupils, often seeing a problem from an entirely different standpoint.

Similarly, it will not always be the pupils who provide the computing experience and expertise. As mentioned earlier, teacher and pupil may well need further assistance in order to produced a polished programme which is of professional quality, irrespective of how simple or complex it is in structure.

There is also the considerable advantage of teachers working in groups to exchange ideas and expertise or to cooperate in the collection and exchange of data. The regular workshop can be a most valuable form of assistance to such curriculum development. If this type of cooperation is changed in scale from local to regional cooperation, it becomes valuable in other ways, for then there could be a wider range of types of data available overall. An example of how one project is involving teachers groups in the development of programmes is explained in the next section.

The main aim of the MEP geographical database project at the University of Bath is to produce databases and supporting materials, both programs and documentation, designed to provide case study and resource material for use in geography teaching in the secondary school. More specifically it is intended to produce a set of programs to construct and interrogate data in a way that will illuminate spatial patterns and spatial inter-relationships between variables within a database. To give an example, a database drawn from the Bristol inner city region would allow the user to construct a

choropleth map of rates of unemployment, or to find those areas in the region where it is true both that unemployment is above 8% and the average household size is about 4. These areas could then be indicated on a map of the region which showed the administrative boundaries and such major influences as the transport routes. The programs will also provide the facility to draw cross sections across a region, with height proportional to such data as the number of shops per square kilometre or the population density.

It is envisaged that the package will be used in three ways. Firstly, as a medium whereby pupils and teachers can design and create their own databases; secondly, as a tool in investigative project work perhaps as part of an examination; and thirdly, as a classroom teaching aid, allowing maps to be drawn quickly and easily in response to classroom activities and pupil feedback.

The package will include a number of ready-made databases using data drawn from various regions within the south-west. In themselves they will provide a resourc that teachers can use within their current curriculum, but in addition we hope they will act as a stimulus for teachers to create their own databases and as examples on which users can model their own database design. It is thus very important to examine ways in which teachers could contribute to this project and to what effect.

At first sight it could be assumed that their most productive contribution would be in collecting data. It is estimated that a curriculum development group of between 3 and 6 active and committed members would take between 6 and 9 months to collect the relevant data, for example from the census or from planning departments, to convert the data to a form that can be used by the project, and to translate it into machine readable form. We are at present

engaged in utilizing and forming such groups, some of which will receive financial support from their local education authorities in the form of day/half-day secondments. These groups will also play the active role in designing the database. By encouraging a group to choose the region to be studied, and to choose the variables that will be measured for the given region, we can go some way towards ensuring that the package will have relevance to current syllabuses, and will furthermore be of general academic interest to geography teachers. The groups will also choose the sources and methods by which the data is collected, which may involve field work conducted by pupils, and in so doing take responsibility for its accuracy.

However there is a more fundamental role that teachers can play in this development of computer resources. Whilst the production side of the project, the programming and technical side of system design, is left wholly to a professional curriculum developer/programmer, in all other aspects teachers are encouraged to make decisions, to offer guidance, and to influence the form and function of the final product, acting both as architects and as quality controllers.

Indeed, with the project still at an early stage, their guidance with regard to specific aspects of the system design has already been invaluable, both in pointing out the omissions and inadequacies of the draft design, and equally important, indicating areas where the package specification was over-elaborate.

Some key questions being considered are:-

Should the maps displayed be in colour, possibly at the expense of clarity?

Should we give users the option of direct and easy access to the data itself or would this somehow draw attention away from the main aims of the program?

Would it be useful if the computer programmes provided a facility for statistical calculation and analysis?

Teachers, particularly those unfamiliar with the technology, cannot be expected to spend many hours unravelling intricate programs - the area between programs that are usable and those that are over-sophisticated is a grey one and professional programmers or curriculum developers, or even 'computer literate' teachers, are not necessarily the best qualified personnel for defining the optimum level of sophistication. Yet this question becomes very important when we consider the problem of introducing the package to the classroom and to teachers inexperienced in using computers.

The process of system design has involved constant references to local curriculum development groups, as well as experts further afield, and this process will be continued throughout the various implementation stages. As quality controllers teachers have already provided instant critical response to new programs in terms of their usability. Perhaps inevitably, the most searching and useful comments in this area come from those teachers not completely familiar with either the technology or the concepts of computer assisted learning.

As the technology becomes more advanced and more readily available, and teachers become more familiar with the concepts, so demand will grow for programs that combine speed and efficiency with ease of use, take full advantage of high resolution graphic and colour facilities, and are available

complete with comprehensive documentation.

At the top end of the market it is unrealistic to expect teachers to produce this quality of software, and recognition of this fact has led to the funding of various projects, including the geographical database project at Bath. The project's basic philosophy is that the work is developed as a joint exercise, with practising geography teachers expressing their needs to a programmer and cooperating with him to produce the required materials.

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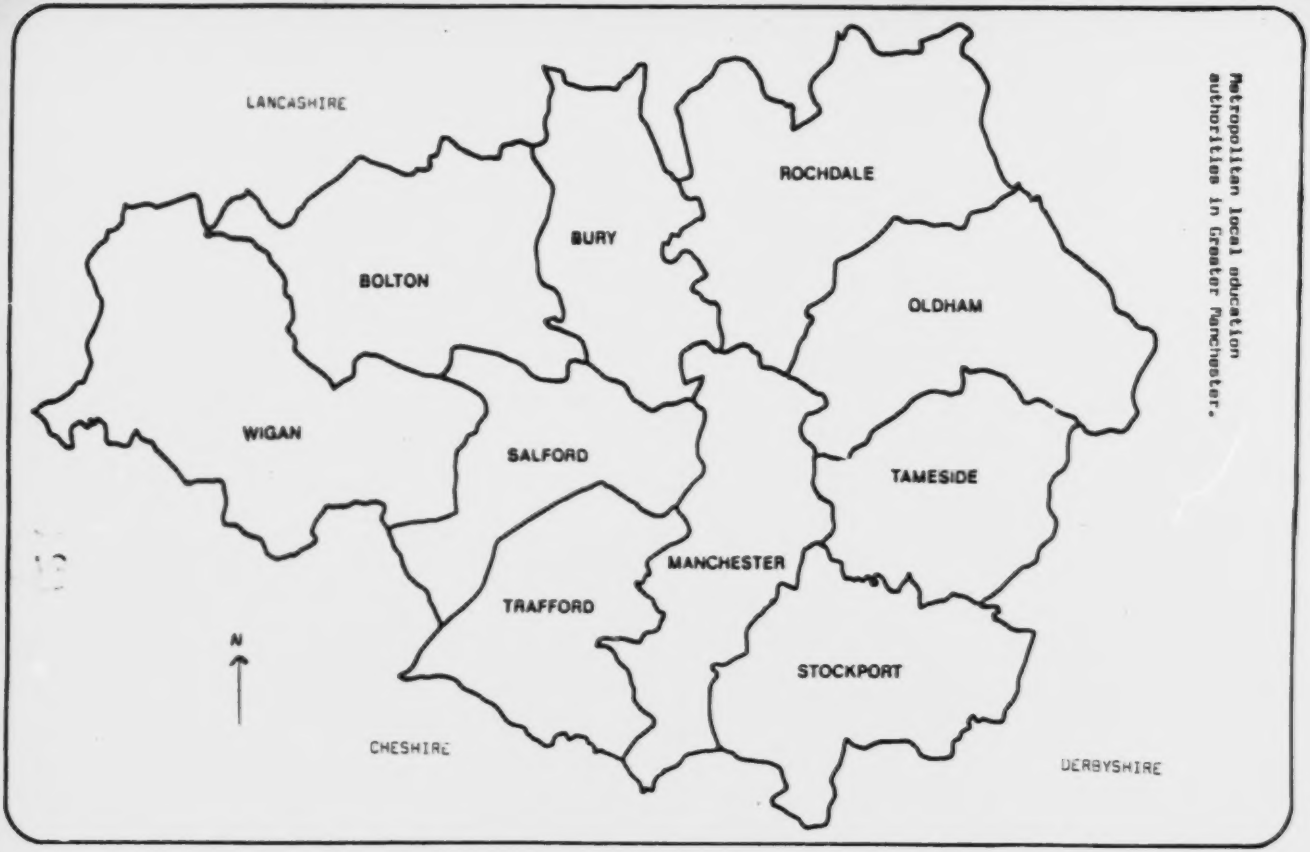
ASPECTS OF PRE-SERVICE AND IN-SERVICE TEACHER EDUCATION WITH REFERENCE TO COMPUTER ASSISTED LEARNING IN GEOGRAPHY

Robert Barr and Michael Williams
University of Manchester

In this paper we reflect on approximately a decade of pre-service and in-service teacher education with reference to the relevance of computers for geography teachers in secondary schools. We will present a review of our experience, an agenda for teacher education and some wider perspectives on the relationship between geography and computing.

In-service courses for geographers and geography teachers are provided by two agencies in the University of Manchester: the Department of Extra Mural Studies arranges courses for the general public and includes in its annual programme substantive courses designed principally for geography teachers. The Department of Education has a Centre for In-Service Studies and this arranges courses of a pedagogical kind. We have organized and contributed to courses sponsored by both agencies. Pre-service students, attending the Postgraduate Certificate in Education course (PGCE) are registered in the Department of Education. Both the Department of Extra Mural Studies and the Centre for In-Service Studies advertise their courses to schools in Greater Manchester; a conurbation of some 2.5 million people, comprising, since 1974, ten metropolitan local education authorities; and the neighbouring shire Counties (each an Education authority) - Lancashire, Cheshire and Derbyshire (Figure 1).

The Department of Extra Mural Studies has become the principal provider of in-service education for geographers in the Greater Manchester area. Over the last decade courses have concentrated on helping teachers to become familiar with 'new', mainly quantitative, aspects of geography in the light of revised



Metropolitan local education authorities in Greater Manchester.

Figure 1

courses for school examinations emanating from the GCE A level boards (General Certificate of Education Advanced Level examination are taken in England and Wales by children at the age of 18 and are the principal qualification for university entrance). The new syllabuses introduced by the Manchester based Joint Matriculation board (one of the largest examination boards) have provided a framework for the planning of the 'refresher' courses in geography offered by the Extra Mural Department.

Within the conventional in-service geography courses some attention had been paid to the use of computers in the handling of data in academic geography. Topics such as spatial diffusion, applying the Hagerstrand (1965) model, cannot be thoroughly taught without such reference. However, as the first micro-computers became available in local schools, the normal programme of ten and twenty week courses in fields such as human geography, soil science, geomorphology and climatology, was supplemented by a number of one-day schools designed specifically to provide computer education for geography teachers. These day-schools dealt with the ways in which computers had been used in advanced academic geography before the arrival of the micro; the availability of materials and sources for programs. Further they provided suggestions as to how existing programs could be introduced into school geography. They have provided hands-on experience with computers of the types used in schools. The hands-on exercises included a task which was designed to encourage teachers to consider critically the materials they were using. This was the filling in of a simple report form, for each program used, in which they commented on both its technical and educational merits and how it could be used in the teacher's own situation (Figure 2). Finally the broader impact of the micro on geographical education was considered. Experience has shown that this early agenda was largely satisfactory. It has been incorporated into longer courses and, interestingly, it parallels the core of the Microelectronics Education Programme (MEP) in-service training package for geographers. These short courses

Figure 2

PROGRAM REPORT FORM

Program Name:-

How easy was it to use:

- Did not work
- Very difficult
- Difficult
- O.K.
- Easy
- Very easy

(please tick)

How useful would it be in class:

- Of no use
- Of limited use
- Of general use
- Essential

(please tick)

Did the program contain any noticeable errors?

- Yes
- No

If yes please specify:

How would you improve the program,

a) teaching value

b) ease of use

THANK YOU.

left teachers willing to experiment and keen to try computers in the classroom, but many felt that they needed more experience before they could proceed confidently. To this end the Extra Mural Department has instituted a series of computing workshops for geographers and other teachers in the humanities. These extend over ten weeks and comprise weekly two hour sessions. There is little or no formal teaching during these sessions but participants have access to existing geography programs, to a self teaching BASIC programming package and to advice from a geographer who is also a skilled programmer. Given this free choice most teachers with no programming skill have opted to learn some BASIC, those who do have some programming skill are keen to adapt programs from listings to meet their own needs and the more ambitious write their own programs from scratch. It was our intention that the workshops should also provide an opportunity for teachers to gain an in-depth understanding of some of the more complex programs and that they should design teaching strategies around them. We also hoped that teachers would work in groups to design software, an activity that would have demanded little or no knowledge of computers for the majority of a design group. However, the weekly format and the temptation to 'play' with the machine mitigated against these valuable activites.

As a result of the early work in the Extra Mural Department the Greater Manchester Humanities INSET Consortium (a group of local authority advisers) requested that a DES (Department of Education and Science) funded regional in service course be mounted to provide a core of 'key teachers' to assist in the dissemination of CAL ideas among other humanities teachers in their local authorities. Two teachers were nominated by each authority in the Greater Manchester area, and were selected for their classroom skills in their own discipline. Avowed computer enthusiasts were not encouraged to apply whilst a degree of 'healthy scepticism' was welcomed. The format of the course, three to four days per week over four weeks at the end of a

summer term, allowed us to deal with all the topics mentioned above. Enough time was available to arrange program design exercises and to design lessons around existing software which was tried out and was constructively criticized. During the following term a number of teachers, who had attended the course, organized conferences and teachers groups to follow it up. It appears that the 'multiplier effect', hoped for by the advisers, is working.

The topics that we have chosen to include in our courses leave two major issues unresolved. The first is the extent to which geography teachers should be able to write their own programs. The second is how much should a geography teacher know about the inner workings of the computer. Many teacher educators take the view that neither of these are necessary components of the geography teacher's repertoire. We would argue otherwise. Our experience in courses suggests that the discipline of programming is valuable in itself and has a beneficial effect on teachers' approach to other parts of their teaching. Interestingly this aspect of our courses has received support and encouragement from HMI's (Her Majesty's Inspectors of schools - these are the government inspectors responsible for courses funded by the DES) who have commented favourably on this element of both our refresher courses and the DES sponsored in-service course. The inner workings of computers, however, remain largely a mystery to geography teachers. Perhaps they accept the comment of a widely used history textbook, which having dealt with the complexities of the steam engine and Concorde with equanimity,states that 'computers are such complex devices that they cannot be understood by the ordinary person'. We feel that such obfuscation should not be tolerated.

Pre-service computer education for geography teachers has so far followed a path very similar to the in-service programme but we are aware that the needs and prior experiences of the two broad groups are likely to diverge as the computer becomes more

commonplace in schools and undergraduate courses include more computer training. For the student teachers the exigencies of teaching practice make them much more aware of the need to integrate programs into their lessons whilst the more experienced teachers are more concerned with the logistical difficulties of getting a micro into the geography classroom.

Pre-service and in-service courses for geography teachers have been hampered by the vexing lack of computer materials. Geography has been cited as a subject that can benefit from CAL on numerous occasions and has featured prominently in funded developments of CAL materials. The GA (Geographical Association) has been in the forefront of subject associations in recognizing the need for development work and in supportng a fledgling Package (program and documentation) Exchange (GAPE). This has now grown into an active program production unit based at Loughborough University and funded by the NEP. There is also an active Educational Computing Working Group supported by the GA. This group has now moved its area of concern to evaluation and a Package Evaluation scheme has been initiated. A regular 'Computer Page', which includes reviews of programs, will appear in issues of the GA journal 'Teaching Geography'. The annual GA conference has, in recent years, included well attended and popular computer workshops. Yet, despite all this activity and goodwill geography, in common with other disciplines, suffers from an appalling lack of good quality, appropriate software for school and university teaching. A large part of this problem stems from the fact that hardware is developing, and becoming readily available, at a pace that is completely out of step with the time scales of software publishing and development. If our training initiatives are not to be wasted, student teachers and practising teachers will have to be prepared to plug the software gap by their own efforts and by local initiatives.

To establish an agenda for teacher education it is necessary to consider the previous experience of our two potential client groups:

In-service students

To date, surprisingly, many teachers attending in-service courses have never used a micro-computer for any purpose. Where they have used a micro they will either have attended a non subject-based induction course or been advised (possibly badly) by similarly inexperienced colleagues. The existence of a machine, or even a room full of machines, in a school is no guarantee of access for the mildly interested teacher. Geography teachers frequently complain about the difficulties of persuading headmasters or science teachers that their claims on computer time are equally valid. Practising teachers are familiar with dealing with geographical topics in a classroom setting and the practical realities of school life, both of which are very important when preparing to introduce a computer into the classroom.

Pre-service students

At present many pre-service students have had limited, or no, direct experience of using a micro-computer. However this situation is likely to change very rapidly as micros are introduced into schools. Where they have had experience this has usually been very poorly structured and patchy and a 'refresher course' is usually necessary - one can only hope that this situation will improve as students arrive from school and university with substantially more experience. The recent DoI (Department of Industry) scheme to provide large numbers of computers for Departments of Education should, at least, mean that a core of training will be provided outside the geography curriculum and methods component of PGCE courses. This has not been generally available before. It seems reasonable that the basic skills of turning a machine on and off, of loading and

saving programs and of dealing with programs that malfuction (which, of course, should not exist) will not be part of geographical pre-service teacher education in the near future. The pre service student is unlikely to have had substantial exposure to the micro-computer in a geographical context and is likely to be naive about the classroom situation. Pre-service students who become enthusiastic about using computers in their teaching are frequently far too optimistic about what can be achieved in the classroom.

An agenda for training:

In figure 3 we show the trilogy of knowledge, attitudes and skills which is a familiar feature of curriculum design. Both the pre-service and the in-service student of computing in geographical education will arrive with some knowledge and skills (however sketchy) and a set of attitudes. We, as course designers, must take into account the potential diversity of our students. At its simplest this diversity is reflected by the three responses that we meet from geography teachers attending our courses. Some are actually hostile and extremely pessimistic about the role of the computer. They see it as yet another indignity that is being heaped upon them by the innovators who have already all but destroyed geography as they knew it. The second response is one of caution and scepticism, this is frequently the most healthy response. The third response is one of intemperate enthusiasm where the novelty of the computer overshadows any geographical value that programs may have. It is only by anticipating the interplay of knowledge, skills and attitudes in one's students that an appropriate course can be designed.

In deciding what knowledge, attitudes and skills we wish to impart to our students we have obviously been influenced by the importance that we ascribe to computers in school geography. We are aware that some teachers judge the computer to be peripheral

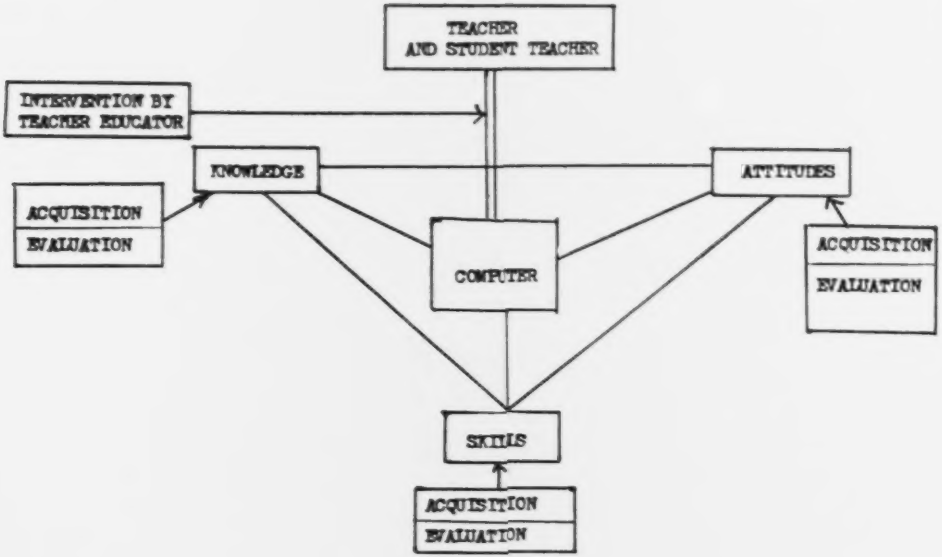

TEACHER
AND STUDENT TEACHER
INTERVENTION BY
TEACHER EDUCATOR
KNOWLEDGE
ATTITUDES
ACQUISITION
EVALUATION
COMPUTER
ACQUISITION
EVALUATION
SKILLS
ACQUISITION
EVALUATION

Figure 3

to the subject and argue that allocating limited resources to in-service education in this field cannot be justified. We would disagree with this view for three reasons. Firstly, and perhaps most trivially, the computer has the potential to motivate pupils to learning, to gain and hold their attention, and already it is becoming evident that other subject teachers are exploiting this potential; geography ought not to lose out in this.

Secondly, and more importantly, geography has always been valued in the school curriculum as a discipline which fosters the practice of a wide range of skills in the fields of literacy, graphicacy and numeracy in the context of the pupils' everyday experience of the world. The computer, with well written and appropriate software, can enhance, and is becoming, an important tool in the practice of, each of these skills. Without wishing to be alarmist we would suggest that without recourse to the computer the skills element in school geography may suffer to the ultimate detriment of the subject's place in the curriculum. This is so for low order and higher order skills. With regard to the latter we would point to the capacity of interactive programs that model some aspect of the environment, often in the context of a game, to help a pupil understand controllable systems and the influence of chance. Data retrieval systems can emphasize the importance of interpreting information rather than simply collecting and memorising it. Graphics based programs can help pupils to understand relationships in a dynamic way which is denied through the use of conventional maps and diagrams.

Thirdly, geography has an established role as a subject which contributes to civic education. Whereas in the nineteenth century it was claimed that geography had a prominent part to play in informing pupils about the role, influence and global importance of the nation, today the subject can be seen as being important for helping pupils to understand their physical and social environments. For this reason the legacy of nineteenth century industrialization, urbanization, and colonialism is powerfully

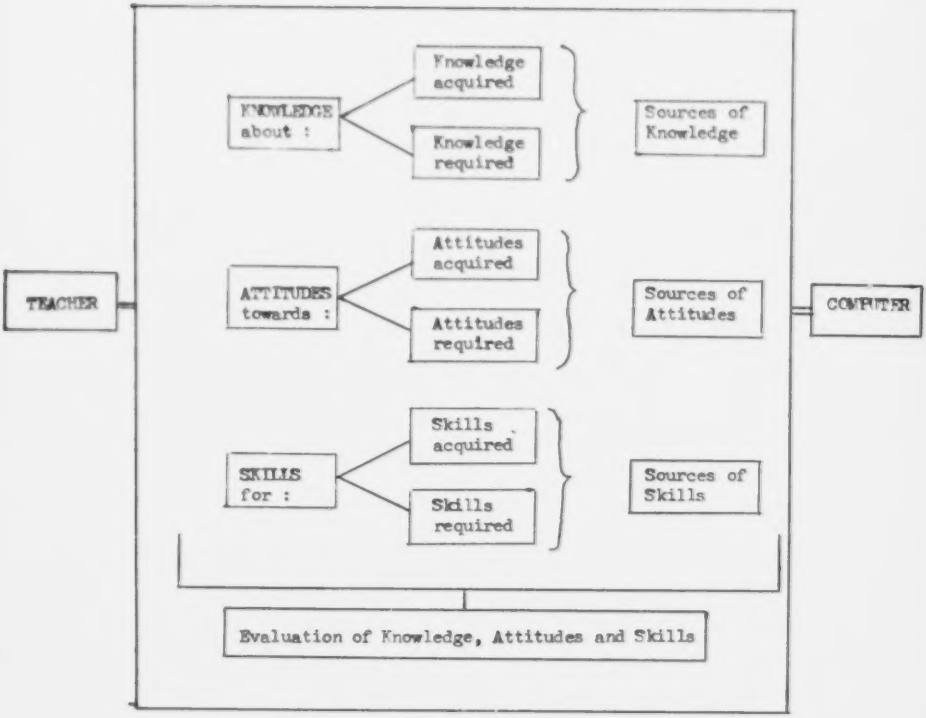
evident in geography syllabuses. Unless geography teachers are prepared to discuss the nature and the potential impact of the new technologies that are bringing about a post-industrial revolution they risk the subject becoming an irrelevance and its replacement by other subjects in the curriculum, as is already happening in some other European countries.

To summarise, our agenda demands that our students should understand how the computer can be used to enliven lessons, hold the pupils' attention and present material in an attractive new way. They should be able to relate the substantive geographical topics, and the skills that a pupil can acquire, to the software that is available (this need not necessarily be specifically geographical software). They should be able to explain to pupils the relationship between the micro in the classroom and computer technologies in the world outside, dealing in particular with the space modifying impact of these technologies. Finally, and optionally, they should be capable of designing and writing programs that help meet the first two aims above.

Having defined the principal items on our agenda let us turn to Figure 4 to help us consider how students' previous knowledge, attitudes and skills will predispose them to courses on computer education in geography.

Courses on computers in geography must compete for attention with a wide range of other in- and pre-service offerings and students will place them in their own order of priority. The diagram draws our attention to the important distinction between the knowledge, attitudes and skills already acquired by a teacher or student teacher and the knowledge, attitudes and skills which they require for their own, private, individual ends. Both of these sets require careful evaluation by the course designer, as do the sources of knowledge, attitudes and skills. At its crudest one can anticipate differences between teachers who have gained their experience ofcomputers in amusement arcades and those who have

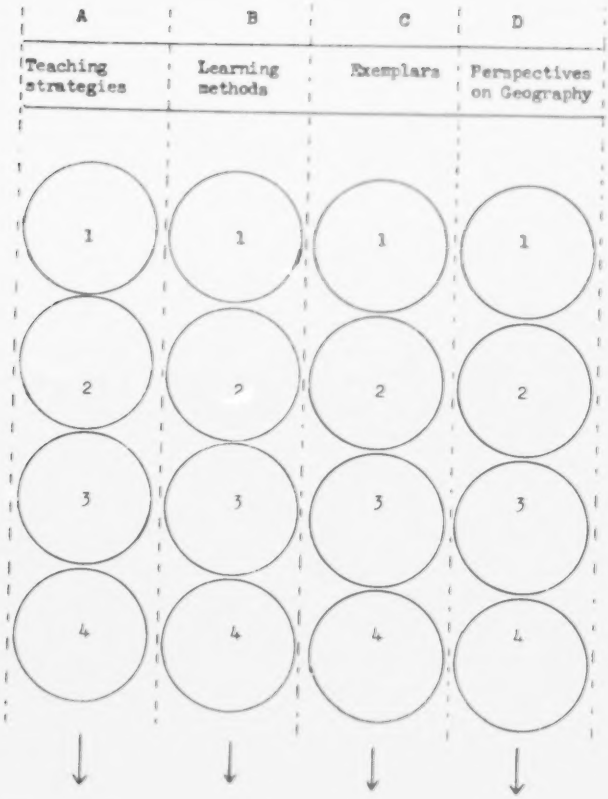
Figure 4


TEACHER
KNOWLEDGE about :
Knowledge acquired
Knowledge required
Sources of Knowledge
ATTITUDES towards :
Attitudes acquired
Attitudes required
Sources of Attitudes
SKILLS for :
Skills acquired
Skills required
Sources of Skills
Evaluation of Knowledge, Attitudes and Skills
COMPUTER

followed a television course.

For teachers and student teachers the computer is often seen as a means, and only one of several means, to a particular end. If viewed as a new method of teaching old information then the teacher balances the computer against existing methods. As with the use of audio-visual aids, some teachers conclude that well tried teaching techniques, especially chalk and talk, combined with dictated notes, have proved adequate in the past and the case for introducing radical change has not been convincing. Particularly where that change carries with it such heavy over heads of learning to handle the technology, inconvenience and cost. Such extreme positions are not the monopoly of cynical classroom veterans working in the siege conditions which seem to characterise some inner city schools, they can also be found among student teachers. As with the pupils they teach, teachers attend courses in groups characterised by a mixture of abilities, interests and motivations. Teacher educators are faced by the same problems as classroom teachers in designing courses which incorporate a variety of teaching and learning strategies, a mixture of exemplars and several geographical perspectives. These varieties must be structured and sequenced and, especially in the case of student teachers, be set in a broader course of teacher preparation. This selection problem is illustrated in figure 5. We suggest in figure 5 that teaching strategies, learning methods, exemplars and geographical perspectives maybe seen as discrete components of course design. The division is made only to highlight the four components and to illustrate that they may be viewed as structured sequences. We concede that the division is theoretical and that in reality courses are designed and taught with the components mixed in such a way as to make any detailed analysis difficult for the stranger to understand. The diagram is useful in the context of this paper since it has two applications. First, it poses in a clear way the problem implicit in the design of pre-service and in-service teacher education courses for CAL. Second, it can be applied to the place of CAL in

Figure 5


A
B
C
D
Teaching strategies
Learning methods
Exemplars
Perspectives on Geography
1
2
3
4
1
2
3
4
1
2
3
4
1
2
3
4

existing geography courses taught in schools. Pre-service and in-service courses are constrained by many factors, including the availability of time, resources and teacher expertise. Priorities must be established and there must be congruence between the course providers and the clients. We have experienced the problems of defining the precise needs of teachers and student teachers with regard to computers and our response has been the range of provision that we have described. Teachers have expressed varying degrees of satisfaction with what we have to offer. Student teachers have benefited from, and enjoyed, individual access to microcomputing resources and short courses. With regard to the latter we should point out that the arrangement of teaching practice in the Manchester PGCE course has facilitated the introduction of microcomputing for student teachers. In the winter term students spend the final six weeks of the term in secondary schools on teaching practice. In the spring term they spend four weeks in the Department before attending another secondary school for six weeks. We have provided an eight hour taught course on microcomputing in geography during the first four weeks of the spring term. Having experienced one period of teaching practice in which they have learned the basic elements of class management, lesson planning and having become familiar with the geography syllabuses used in secondary schools, students approach the second practice with more confidence than they did the first. They sometimes have the opportunity, in this practice, to apply the lessons that they have learned in the microcomputing unit to their teaching. It would be foolish to suggest that opportunities for this are commonplace at present. Far from it, most students would count themselves very lucky if they observed a geography teacher using a computer. Nevertheless, in recent years student teachers have worked alongside teachers who had attended our in-service courses and they have been encouraged by these teachers to consider using computers in their lessons. In the current year five out of the eleven geography students have had this experience.

In pre-service education at Manchester the time available for a curriculum and methods course in geographical education is considerable. Until now we have experienced no difficulties in allocating time for a course in microcomputing. Though some would argue that eight contact hours is a small amount of time, when compared to the time given to class teaching on the effective use of audio-visual aids, such as radio and television, it appears a very generous allocation. For the student teachers the time is extended by the access they have individually to a variety of different types of microcomputers and software both in the Department of Education and the Department of Extra Mural Studies. In schools they have access to fairly generous computing facilities in certain local authorities, some of which provide specific computing support services for geography and the humanities.

Conclusions

We are convinced that the integration of both CAL and a geographical element of computer appreciation is essential in school geography. The sign of success of our, and our students' efforts, will be the disappearance of the computer as a 'star performer' in the classroom it will become as transparent as the overhead projector or the weather station. Its use will become a matter of routine both as an instructional aid for the teacher and a tool for the pupils and both will expect to use it routinely in their work. Topics such as mapwork throughout the geographical curriculum will include both the practical use of the computer and the appreciation of their role in the production of national map series as those produced by the British Ordnance. Survey. Such work may lead on to topics such as the value and the ethics of linking personal data to home addresses and map-based computerised information systems. The computer will have arrived when we stop talking about it and take it for granted.

Postscript

New technology and new topics have to fight for recognition. It is interesting to note that aspects of old technology are often dealt with across the curriculum. Take steel making for example, no self respecting traditional geography course would have left out coverage of the iron and steel industry and even the 'new' more theoretical discipline deals with it as an interesting example of Weberian location problems. But the pupil will be drawing blast furnaces in his social and economic history course, in his chemistry course and probably in his metalwork class as well. Perhaps a nineteenth century version of today's meeting would have been dealing with the role of steel making in the geographical curriculum - or would it have been steam engines?

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"SETTLEMENT UNIT" : A co-ordinated suite of analytical programs and data files designed for a specific geography syllabus[1].

J. R. G. Jennings

THE SCOTTISH SCENE

Scotland, although part of the United Kingdom, has a separate educational system and its own Education Department (S.E.D.) within the Scottish Office. As a result of this separation, it has pursued its own course of development in computer assisted learning (C.A.L.).

Similarly, the public examinations in Scotland are under the auspices of the Scottish Examination Board (S.E.B.) with serving teachers occupying many of the key roles as examiners and question setters. In the mid 1970s the Ordinary Grade (O Grade) and the Higher Grade (H Grade) syllabuses of the S.E.B. in geography were completely re-designed to take account of the newer concepts and methodologies in the subject.

The H Grade syllabus specified, among other items:

i) methods of collecting, storing, ordering and representing information using statistical and diagrammatic techniques,

ii) the use of theoretical models as a simplification of reality,

iii) classification of data.

A further list of recommended techniques mentioned :- correlation, regression, gravity models, accessibility matrices, logarithmic scales, and nearest neighbour analysis. It also suggested that C.A.L. might be used.

1. *Issued jointly by Aberdeen College of Education and the S.C.D.S. (Glasgow), for use in Scottish schools.*

The Scottish geography teachers took up the new syllabuses with enthusiasm and, within four years, 80 per cent of schools were teaching the new H Grade syllabus[1], although the old syllabus is still available until 1984.

SETTLEMENT UNIT

It was against this background that my colleague, Mr. N.M. Smart (Head of the Computer Education Department at Aberdeen College), and I carried out our development of the programs listed in Fig.1.

From the beginning we attempted to identify those topics in the new geography syllabuses which would benefit from the use of C.A.L. Topics we knew that all Scottish geography teachers were teaching at 'H' Grade and to some extent at 'O' Grade as well. We avoided what Deryn Watson has so aptly called "random pecking", that is an arbitary choice of topics for C.A.L. irrespective of whether they were widely taught or not. It is interesting to see how our choice of topics for "Settlement Unit", although selected for the Scottish 'H' Grade, are relevant to many English 'A' level syllabuses as well (Fig.2). We hope our forthcoming programs (Fig.1) and our work in the field of geography data files (Fig.3) will also have relevance outwith Scotland.

We developed the programs originally as batch versions and tested them in twelve pilot schools throughout Scotland. This was financially supported by the Scottish Colleges of Education[2]: without their support and the encouragement of the Scottish H.M.I. (schools' inspectors) in geography, it would have been very difficult for us to have carried out the work. An important point here is that C.A.L., in any curriculum area, needs financial support and encouragement from the educational authorities if significant numbers of properly tested programs are to be made available.

The rapid development of micro-computers and their purchase for every secondary school in Scotland meant we had to re-design our programs for micros[3] at a late stage in their development. Hardware developments out-

1. *GORDON, G. "The Spread of the Alternative Syllabus" p31-43, Scottish Geographical Magazine, Vol.99, 1983.*

2. *Scottish Colleges of Education Research Project R/7/S*

3. *Initially APPLE II and CROMENCO: B.B.C. and RML 3802 versions under active development now.*

FIGURE 1

ABERDEEN COLLEGE OF EDUCATION
GEOGRAPHY AND COMPUTER DEPARTMENTS

C.A.L. PROGRAMS

Settlement Unit (published in Scotland)

ZIPF	Rank Size Rule
NEIGHBR	Nearest Neighbour Analysis
RELAC	Relative Accessibility
REILLY	Urban Field break points
GRAVMOD	Gravity Model

Statistics for Geography (to be published late 1983)

CHI-SQ	Chi-square
CORREL SPEAR	Spearman Rank Correlation
CORREL PPM	Pearson Product Moment Correlation
CLASS	Data sorting and classification
REGRESSION	Regression analysis, line of best fit

Programs under Development

HIERARC	A Hierarchical grouping program for settlements etc.
DIFFUSN	A Diffusion Simulation using Monte-Carlo model

* * * * *

SETTLEMENT: Concepts and Techniques

Scottish 'H' Grade and Selected English 'A' Level Geography Syllabuses

E = Explicitly mentioned I = Implicit in the syllabus wording

Technique/ Concept	Examination Board							
	S.E.B.	Oxford	Oxford/Cambs.	Cambs.	London	J.M.B.	A.E.B.	S.U.J.B.
RANK SIZE RULE	E	I	E	I	E	E	E	E
GRAVITY MODEL	I	I	E	I	E	E	I	I
NEAREST NEIGHBOUR ANALYSIS	I	I	I	E	E	E	I	E
SPHERE OF INFLUENCE	E	I	E	E	E	E	E	E
RELATIVE ACCESSIBILITY	I	I	E	I	E	E	E	E

FIGURE 2

FIGURE 3

ABERDEEN COLLEGE OF EDUCATION - GEOGRAPHY AND COMPUTER DEPARTMENTS

A. Data Files Already Prepared

Title	Cases (countries/states etc.)	Variables
World (mid 1970's)		
Demographic, Social Economic	125	230
E.E.C. (1970's)		
i) Demographic, Social Economic	140	89
ii) Climate	77	19
Brazil (1971)		
Physical, Demographic, Social Economic including inter-state migration	31	203
India (1971)		
Demographic, Social, Agriculture	30	110
Scotland (1971)		
i) Settlements 100+pop^{n}	1,390	5
ii) Regions and Districts	65	40
iii) Parishes: physical, demographic, social, agriculture and land ownership	891	122

B. Data Files Planned

Title		
England and Wales (1981) Regions and Districts		
Nigeria - states		
U.S.A. - states and counties	3,000+	190
Canada - provinces and districts		
Scotland (1981)		
Regions and Districts		
Settlements 100+ pop^{n} if available		
Major cities - districts		
U.S.S.R. - republics and autonomous regions?		

stripping the rate of educational software production is a serious and continuing problem as is the wide variety of different micro-computers being used.

DATA FILES

Our work on data files sprang from the work on the Settlement Unit programs. We quickly realised that we had developed powerful, analytical tools, but it was difficult to obtain enough data to take advantage of them. Also, entering large quantities of data through the keyboard was very tedious, time-consuming and prone to errors. Thus, we experimented with data files held on disc that could be used in conjunction with the analytical programs if the user had a main frame computer or twin disc drives on a micro.

The S.E.D. gave us financial support[1] and a research assistant was employed to collect the data for substantial files based on the specified regions of the 'H' Grade syllabuses. Fig. 3 gives some broad indication of the files developed and their size. In addition, with the "Settlement Unit" we have issued a data file disc of sample data for the programs, plus a basic file of Scottish urban data. All data files we issue will, through our program "Filelist" be compatible with all our analytical programs.

Compiling the major data files proved a much more difficult task than originally anticipated. It is difficult, in many cases, to obtain up-to-date, accurate data at even national level and, far worse, at provincial and planning region level. The area that gave us the greatest difficulty was E.E.C. where member states and even provinces all go their own ways in the data they collect and the form in which they publish it.

Perhaps data files of this type could be a focus for I.G.U. educational activity. In that respect, I am very interested in the remarks by our Netherlands colleague concerning Data Interchange Format (DIF) and I will be pursuing the matter to see what it has to offer in respect of our data files. My colleague, Norman Smart, and I, would like all our material to have as wide a circulation as possible, because it is prodigal if C.A.L. in geography uses expensive and scarce resources to develop numerous parallel versions of the same programs and data files. Secondly, obtaining data and updating data files is a big task and might be better done at source by geographers in the countries concerned. They could periodically submit the agreed data through an agency such as I.G.U. following a common format in terms of variables and cases.

1. *Scottish Education Department Research Project H/134/1.*

FIGURE 4

A GEOGRAPHICAL INVESTIGATION

1. Identification of the problem (or question).

2. Formulation of a hypothesis or series of investigatory stages.

3. The investigation and collection of appropriate data for analysis.

4. The selection of appropriate analytical technique(s).

5. Application of analytical techniques to the data: (the arithmetical work).

6. The interpretation of the answer in light of the original problem or question.

7. The identification of unexplained aspects.

8. The determination of further lines of investigation to deal with unexplained aspects or to deal with new lines of enquiry that now arise.

RELEVANCE TO THE TEACHING SITUATION

Even educationalists well disposed towards C.A.L. might quite reasonably ask the question as to whether C.A.L. is really of value using the programs we have developed. In Fig. 4 a route through a geographical investigation is set out and within the total work the application of the appropriate analytical technique is just one of several stages. It is an important stage and it must be used correctly, but obtaining a numerical answer or a correlation index must never become an end in itself. The interpretation of the answer and the fresh questions that this opens up are the most important concerns. Quantitative techniques in geography at one stage looked as though they would founder on the amount of calculation required. The microcomputer program, properly used, can save us from that and return the focus of the work to its proper place, the geographical problem under investigation. Likewise, data is important and on many occasions will have to be collected individually through field work or library research, but, where data is already published, it is far better for the teacher and the pupils to be able to access it quickly and efficiently with much reduced chances of error through a micro floppy disc. Secondly, a great deal of time can be saved by a development project, being able to search out the data from the wide variety of sources and make a selection of those items that are most useful. The time this saves in the individual classrooms can be used to interpret, compare and draw conclusions from far wider data banks than any one teacher could hope to produce.

DOCUMENTATION

In addition to the actual programming there are the important aspects of its presentation to teachers and pupils. We believe the documentation accompanying programs has a very important role to play in:

i) providing all the necessary background, both geographical and technical,

ii) showing how the program might be used in a teaching situation,

iii) in reassuring the teacher new to C.A.L. that there is nothing inherently difficult in using this approach provided there is careful and conscientious preparation.

[Fig. 5 is the Contents Page from the program RELAC (relative accessibility) to illustrate these points]

FIGURE 5

RELATIVE ACCESSIBILITY

CONTENTS

	Acknowledgements	Page 1
	Preface	Page 3
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2	Geographical Background	Page 5
3	A possible teaching sequence	Page 8
4	Selected Bibliography	Page 12

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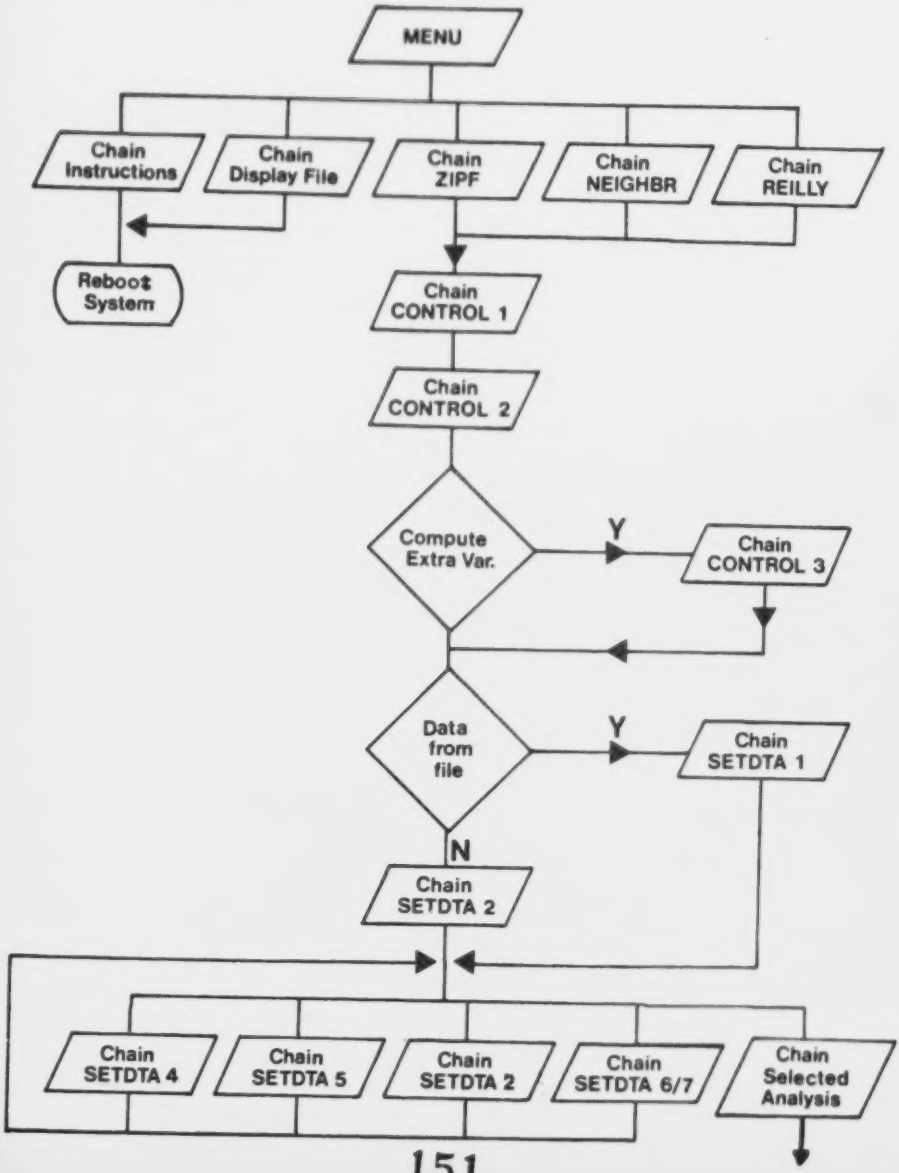
USER GUIDES

Microcomputer/Interactive Version	RELAC/I/UG/01
Batch Version	RELAC/B/UG/01
Appendix	

Fig. 6: Simplified Flow Chart of a Settlement Unit Disc



To achieve success the documentation must be written in terms familiar to the geography teacher and build on existing skills and knowledge. Satisfactory or even good programs can be rejected if they are presented in unfamiliar terms to geography teachers.

The similarity in layout extends beyond the documentation into the actual program format on the screen. Fig. 6 is a flow diagram of one of the two "Settlement Unit" program discs and it can be seen that the individual analyses are served by common sets of sub-routines which will also figure in our future programs. Thus, familiarity with one program is familiarity, to a large extent, with all of them.

The first set of programs have taken far longer to produce than we anticipated, but as this whole area is still relatively unknown territory, it is very difficult to make accurate estimates of the time it will take. What consumes a great deal of time is not devising the initial working versions, it is making them thoroughly robust and testing them to every limit before releasing them. Norman Smart and I are certain that, having got the first set to the required standards, others can follow in fairly rapid succession because of the common formats used. We hope teachers of geography will find them useful and that there will be sufficient interest to make their widespread dissemination worthwhile well beyond Scotland.